JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

CONTENTS

SECTION A. General description of the project

A.1. Title of the project:

Biogas utilization for generating of electricity and heat at the farms of Ukrainian Dairy Company Ltd.
Version: 07.
Date: 27.01.2010.

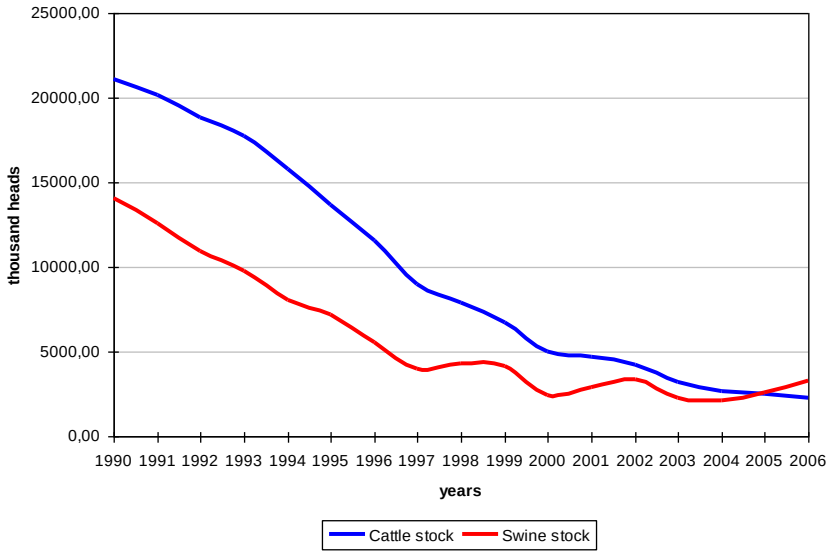
A.2. Description of the project:

Nontechnical project conclusion

The suggested JI project foresees construction and putting into operation biogas plants at two dairy farms which total capacity as of 2010 will constitute 10000 cattle heads. In the digesters of the biogas plants livestock manure will ferment under anaerobic conditions with the help of methanogenic bacteria at mesophilic (34-37ºC) temperatures. Biogas received in the result of fermenting (nearly 60% methane and 40% carbon dioxide) will be supplied to the cogeneration plant for generating electric energy and heat. At present the livestock manure goes into anaerobic lagoons where methane emissions take place. In project realization due to methane utilization the emission of this greenhouse gas will be reduced.

Description of the project environment

The economic crises in Ukraine that appeared as a result of the break up of the Soviet Union led to significant decrease in agricultural production. Having lost government grants big collective farms became unprofitable and stopped their operation or were privatized. As a result in 1990-2006 cattle and swine livestock in agricultural enterprises of all forms of property reduced by 89 and 77% correspondingly (picture 1).[1]



Picture 1. Dynamics of cattle and swine livestock in agricultural enterprises of all forms of property in 1990-2006.

In 2001-2002 it became possible to stop decrease in swine stock due to government grants, purchasing of new swine breeds abroad and revival of some swine complexes. Unfavorable weather conditions in 2003 led to harvest failure and consequently price increase for feeder grain and other

[1]Ministry for the environmental protection of Ukraine (2008). Ukraine's National Inventory Report on GHG emissions and absorption for 1990-2006.

livestock fodder. As a result swine stock in agricultural enterprises decreased dramatically (by 33% in comparison with 2002). In 2004-2006 the number of swine began to increase gradually and in 2006 practically achieved the 2002 figures. According to picture 1, in Ukraine a cattle stock decrease from year to year and it's too early yet to speak about overcoming of the cattle livestock decrease trend.

At the present stage of economic reformation the development of agricultural sector and, in particular cattle breeding, is hindered by a number of factors, among them unregulated land relationships, absence of legislative, institutionary and organizational guarantee of land market development, high prices for breeding stock, fodders and agricultural equipment, low procurement prices for grain, dairy and meat products, low level of government grants etc.

Due to the lack of necessary budget funds the elaborated village development programs are not executed.

Conformity of the JI project to the long-term strategy of the country development

From 90-s one of the most significant aim in the country's foreign economic development has been acquirement of the EU associated membership with the outlook on the EU active membership. The Resolution of the European Parliament of 13 January 2005 has become a valuable step for Ukraine in its way to the EU. The Resolution contains the appeal to the EU Council and European Commission "to consider, besides the Plan of actions in the framework of the European neighborhood policy, other forms of association with Ukraine…, providing this country a distinct European perspective that eventually can lead Ukraine to the EU membership".

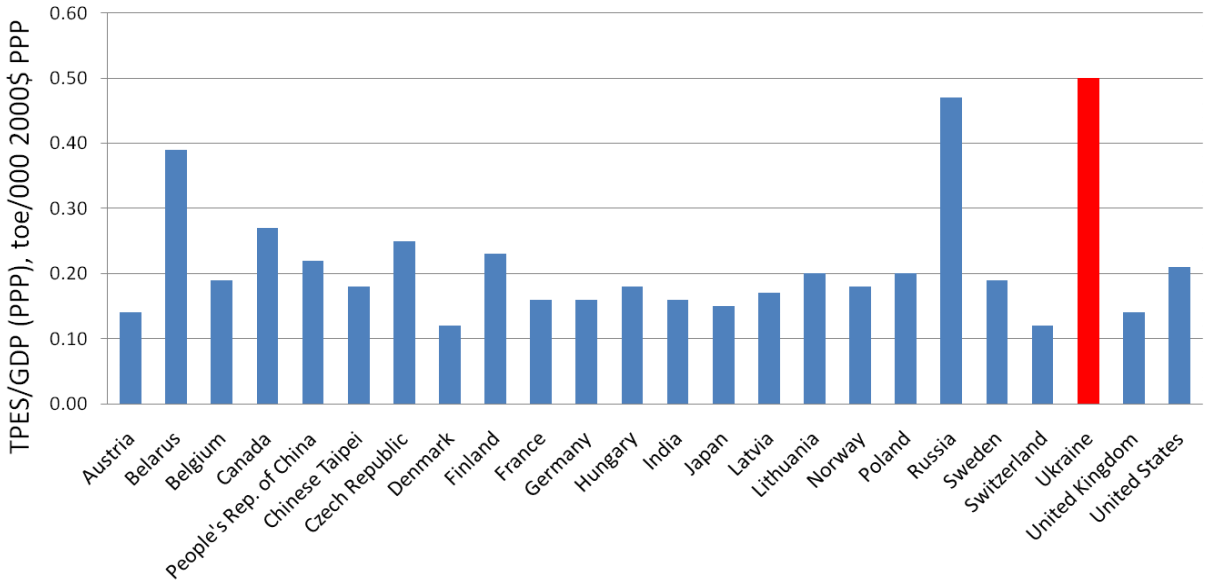
Within the European Union (EU) the agricultural policy is a separate component of the European Union economic policy and has the name the Common Agricultural Policy (CAP). The CAP realization needs significant financial sources, though as of today the CAP is one of the most substantiated directions of the state regulation of agricultural production in the world practice.

Among the main CAP features it's necessary to outline the following:[2]

- transfer from support of definite types of production to direct support of agricultural manufacturers, aimed at creation of a competitive environment in agricultural production;
- expanding of agricultural development support programs, income diversification in villages at the expense of cooperation, improvement of the quality of agricultural production and its marketing, following the basic standards of the environmental protection and keeping stock, training new technologies, support of young farmers;
- increasing of budget for rural development;
- allotment of target grants for depressed zones development to support vitality of regions that are characterized by less profitable economic and social conditions for agricultural production development or its limitation in favor of environmental conservation;
- transfer to the policy of the "crisscross responsibility" that foresees dependence of grants on compliance with the basic ecological requirements as to the state of farm lands, hygiene and keeping livestock and compliance with the standards as to the animal waste management systems;
- implementation of a target support of special agro ecological measures in the process of agricultural production, including scientifically grounded applying of organic and mineral fertilizers, conservation of agricultural lands, ecologically reasonable forest planting and oxidation of farm lands, preservation of agricultural landscapes, planted lands, swamped sites, drains, forest plantations, flora and fauna.

On the basis of the above mentioned, it's possible to state that Ukrainian ecological legislation in perspective in the course of realization its plans as to the country's integration to the EU will become more demanding. Herein, ecologically save manure management will become one of the main livestock farms problems.

Taking into account that the suggested project has energy component (generating of electrical and heat energy), its compliance with the energy development country plans has been defined.
The Ukrainian economy is considered to be one of the most energy intensive in the world according to the consumption of primary energy per a gross domestic product unit (picture 2).[3] Ukraine belongs to a number of a country that partially own traditional types of primary energy and that's why it needs to import them. In 2004 Ukrainian energy dependence on organic fuel was 60,7%, for comparison in the EU countries it was 51%. Taking into account such a situation and recent growth of economic indicators on March 15, 2006 the Ukrainian Cabinet of Ministers adopted "Energy Strategy of Ukraine till 2030" (hereinafter referred to as Energy strategy).



Picture 2. GDP energy intensity in Ukraine (as of 2005).

The Energy strategy includes nine priority directions of energy development, among them – integration of national energy system with the European one, increase of energy exports, decrease of domestic production energy consumption, optimization of own power resources extraction and increase of volume of energy and energy products produced from nontraditional and renewable energy sources.
Herein, the Energy strategy considers exploration of nontraditional and renewable energy sources as a significant factor in increasing the level of energy safety, decrease of energy anthropogenic affect on environment and counteractions against global climate changes. In Ukraine one of the most perspective directions in nontraditional and renewable energy sources development is considered usage of biomass (stock manure, straw, wood wastes, peat, municipal solid waste etc.) in energy aims. According to the Energy strategy economically achieved biomass energy potential in the country as of 2030 in compliance with the base scenario is 3% (including biogas – 0,4%) from the total level of fuel-energy resources consumption. For the moment of the Energy strategy adoption by the government the part of energy generated from biomass was about 0,6% in the country's fuel-energy balance. Thus, implementation of the JI project at the farms of Ukrainian Dairy Company

[2] Ukrainian Agricultural Sector on the way to European Integration: Monograph/ Authors: M. Betliy and others: edited by O.M. Borodina – Uzhgorod: IBA, 2006. – 496 p.

[3] Key World Energy Statistics 2007, IEA. http://www.iea.org/textbase/nppdf/free/2007/Key_Stats_2007.pdf

Ltd. with generated energy and heat from the renewable source (biogas) fully complies with the long term strategy of country development.

Biogas plants – an effective way in solution of problems of manure utilization and GHG emissions reduction

In many EU countries (Germany, Austria, Netherlands etc.) the problem of manure utilization is solved with the help of biogas plants. As a result of biodigesters' work farmers have ecologically clean liquid or solid biological fertilizers without any unpleasant smell, helminthes eggs, weed seeds and nitrates.

Biogas technologies are new for Ukraine. One of the main barriers in implementation of such a practice of livestock wastes processing is the cost of biogas plants. The way out of this situation is using by farm owners flexible mechanisms foreseen by Kyoto Protocol (commitment period 2008-2012). It is possible to reduce significantly the recoupment period of biogas plants using flexible mechanisms by selling emission reduction units (ERUs) generated in the result of methane utilization in a cogeneration plant or flare facility.

Big swine farms with capacity of more than 5000 heads or dairy farms that use modern technologies with cow's population 1000 heads and more are attractive from the point of view of JI projects development in Ukraine. Common practice for above mentioned farms envisages storage of liquid manure in dung-yards or anaerobic lagoons (such conditions are favorable for emissions of greenhouse gas methane).

In Ukraine cattle and swine stock has significantly reduced from the time of the Soviet Union disintegration (see picture 1), but it is still substantial enough. According to the data of statistical form #24 "Report on livestock census" cattle and swine stock in agricultural enterprises of all forms of property as of January 1, 2007 averaged 2,3 and 3,3 million heads correspondingly. Nearly 26% from the total swine stock (846,9 thousand head) is stored under the liquid manure management systems.[4] At the cattle farms, most of which were built in the USSR, solid manure management systems with bedding are commonly used. But recently new cattle farms based on technologies widely spread in developed countries have sprung up in Ukraine. At such farms as a rule liquid manure management systems are presented. Farms of the Ukrainian Dairy Company are a vivid example of new technologies use.

A.3. Project participants:

Parties	Entities – participants of the Project (where necessary)	Indicate if the parties want to be participants of the Project
Ukraine (host party)	Ukrainian Dairy Company Ltd.	No
Ukraine (host party)	Environmental (Green) Investments Fund Ltd.	No

[4] Ministry for the environmental protection of Ukraine (2008). Ukraine's National Inventory Report on GHG emissions and absorption for 1990-2006.

Switzerland	Rutek Trading AG	No

A.4. Technical description of the project:

A.4.1. Location of the project:

The JI Project is located at the dairy farms in Kyiv oblast (herein after referred to as Farm 1) and Chernigiv oblast (hereinafter referred to as Farm 2). Kyiv and Chernigiv oblasts are located in the south and south-east parts of Ukraine correspondingly. Geographical location of the project is given in picture 3.

Picture 3. Location of the Ukrainian Dairy Company Ltd. farms.

A.4.1.1. Host Party(ies):

Ukraine.

A.4.1.2. Region/State/Province etc.:

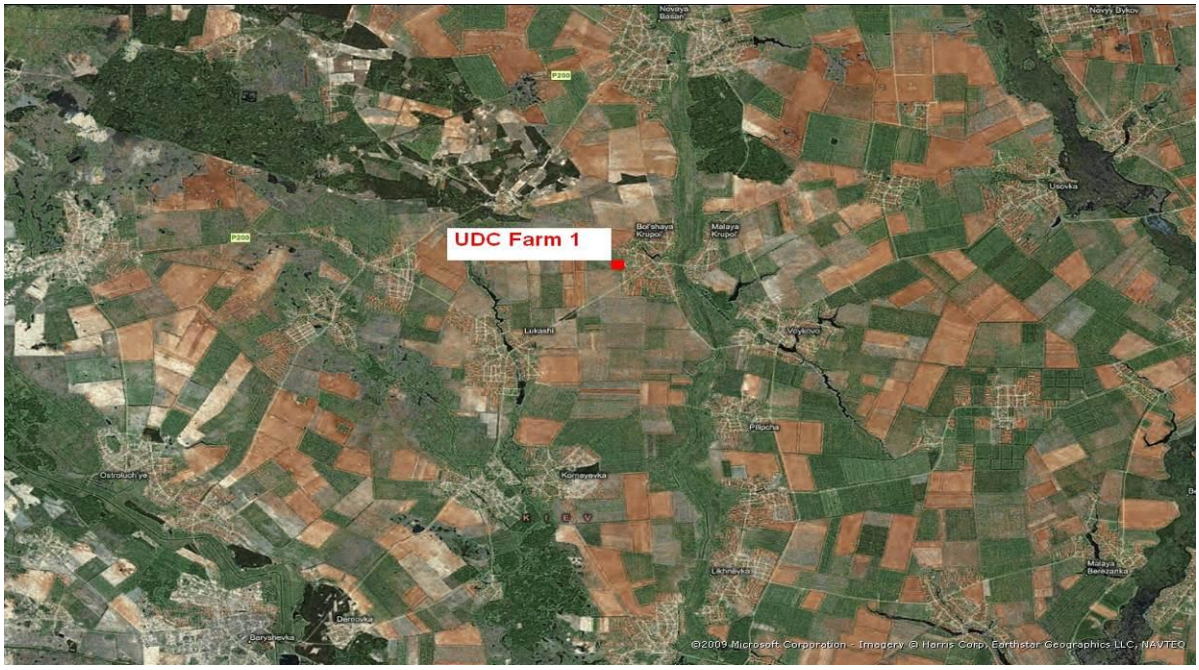
Kyiv and Chernigiv oblast.

A.4.1.3. City/Town/Community etc.:

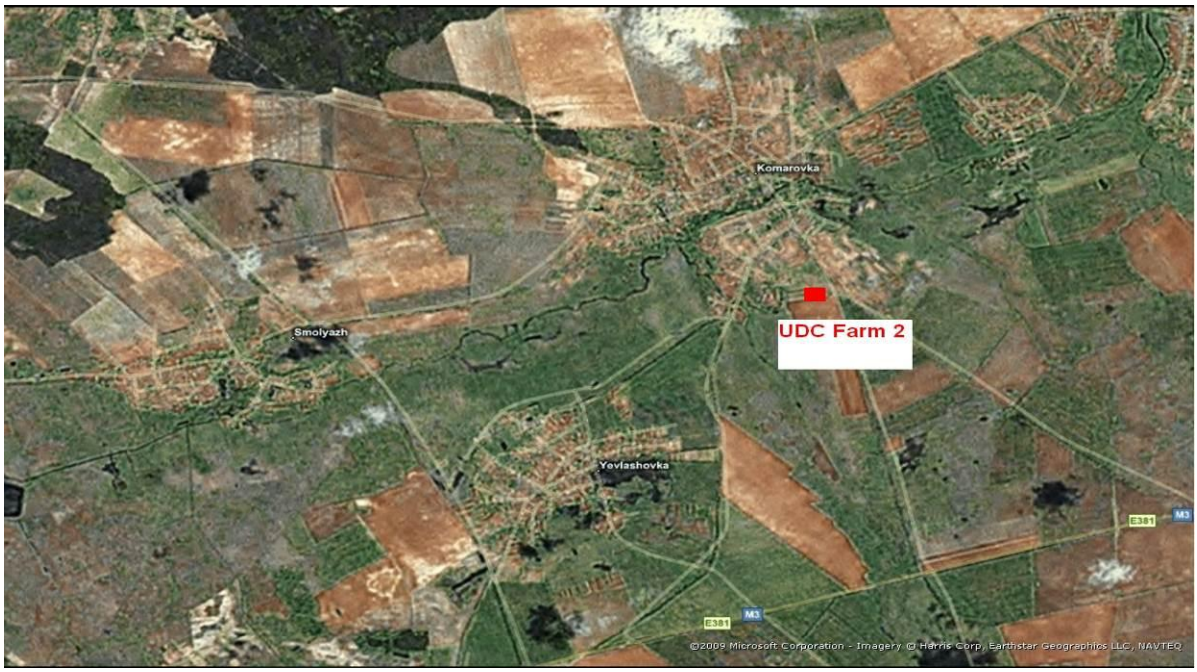
Farm 1: v. Velyky Krupil.
Farm 2: v. Komarivka.

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project (maximum one page):

The suggested project will be implemented in Kyiv oblast, Zgurivsky region, v. Velyky Krupil as well as in Chernigiv oblast, Borzniansky region, v. Komarivka.
Coordinates of Farm 1: N 50º28' E 31º29'. Coordinates of Farm 2: N 51º13' E 32º7'.
Farms' coordinates were measured directly at the object with a GPS-navigator (global positioning system).
Objects of the project are presented at the satellite map (pictures 4 and 5).



Picture 4. Ukrainian Dairy Company Ltd. Farm 1 (Kyiv oblast,v. Velyky Krupil).



Picture 5. Ukrainian Dairy Company Ltd. Farm 2 (Chernigiv oblast, v. Komarivka).

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

The main types of the Ukrainian Dairy Company Ltd. activities according to Classification of Economic Activities are the following:

- cattle breeding;
- growing of grain-crops, industrial crops and off-the-type sorts, which don't belong to other types of plants;
- ready-to-consume fodder for farm animals;
- grain and fodder wholesale trade;
- living animals wholesale trade;
- other types of wholesale trade.

At present time (as of 2008) population of dairy herd at Farm 1 makes up 2000 heads. However already in 2009 it is planned to increase its number twice as much. Cattle population at Farm 2 that will be put into operation in 2010 will make up 6000 head. Both farms will be provided with a flush-flume manure removal system. Operating principle of this manure removal system is explained below: Manure accumulated in the cowsheds is periodically raked up (with the help of a bulldozer) to the premise's centre and thrown down into cross ditches. In cross ditches manure is diluted with sewerages that come from milking parlors. The American Terborg Agro Company's manure flush system is used in manure storages and milking parlors.[5] Manure flush system represents an equipment complex enabling to clear the milking parlor and sump from manure in a few seconds due to the powerful stream. The system is managed from the electrical control panel and its work ensures:

- reduction of manure removal time from the sump up to 10-20 seconds instead of 35-40 minutes when manure is removed with the help of flush system;
- liquid economy due to its repeated usage (circular wash-out);
- reduction of operators number for removal manure from the sump;
- increasing of the sump capacity;
- improvement of sanitary conditions of the milking center operation.

Manure removal in a cross ditch is carried out by a number of Flash and Agy rotary pumps. The pumping system provides manure transportation from the cross ditch, where it comes from the premises for keeping cattle, into anaerobic lagoons. As of today there are four anaerobic lagoons on the territory of the Farm 1, the width and the length of every lagoon are 3,75; 48 and 70 m correspondingly (picture 6).

[5] http://www.terborgagro.com

Picture 6. Anaerobic lagoons at the Farm 1 in Kyiv oblast, Velyky Krupil.

The number of projected anaerobic lagoons at Farm 2 is five. The width and the length of each out of five are 60 and 120 m correspondingly.
Lagoons at the Farm 1 are designed according to requirements of the Technological Designing Departmental Regulations of Agro-Industrial Complex (ВНТП-АПК). In particular, they are paved with a smooth geomembrane Carbofol on both sides (type 406, NAUE Gmbh & Co.KG, Germany) to prevent manure sewers from falling into subterranean waters. Furthermore, manure is stored in lagoons during not less than 6 months for decontamination/disinfection, than manure is pumped into a tank and is supplied to fields as a liquid fertilizer.
However, this method of keeping manure in anaerobic lagoons has also negative features (unpleasant odor, helminthes eggs, weed seeds, methane emission into atmosphere, etc.).
Realization of the JI project at agricultural enterprises of the Ukrainian Dairy Company Ltd. that envisages construction of biogas plants will enable to avoid the above mentioned negative effects accompanying manure storage in anaerobic lagoons.

Biogas plant at the farm in Kyiv oblast, Zgurivsky region, v. Velyky Krupil.
Biogas plant at Farm 1 is to be set into operation beginning from 01.11.2009 (picture 7).
Starting mode for biogas plant presumes step-by-step putting into operation of fermenters. According to the official data from the company-supplier of biogas equipment for the project (Zorg) electrical energy from the grid will be used to power auxiliary equipment in start up period that amounts to 60 days. In particular, consumption of electricity by engines of pumps and mixers will be 33600 kWh. Additionally, for initial heating of fermenters consumption of electricity will be 259200 kWh. According to Environmental Impact Assessment for Farm 1[6] in case of emergency situation co generation units will be operated on diesel fuel (L type, governmental standard on technical conditions - DSTU 3868-99, and maximum consumption – 20 l/h, 0,00478 kg/sec) and biogas will be flared.

[6] Reconstruction with the existing milk farm expansion in the village of Velykyi Krupil', Zgurivsk rayon, Kyiv oblast. Working design, Volume 1 EIA, «UKRNDIAGROPROEKT», Kyiv, 2008.

Picture 7. Construction of a biogas plant at the farm in Kyiv oblast, Zgurivsky region, v. Velyky Krupil.

The site for the plant construction is located in the southern part of the farm.
According to the engineering-geological investigation, lithologically the site is presented by:

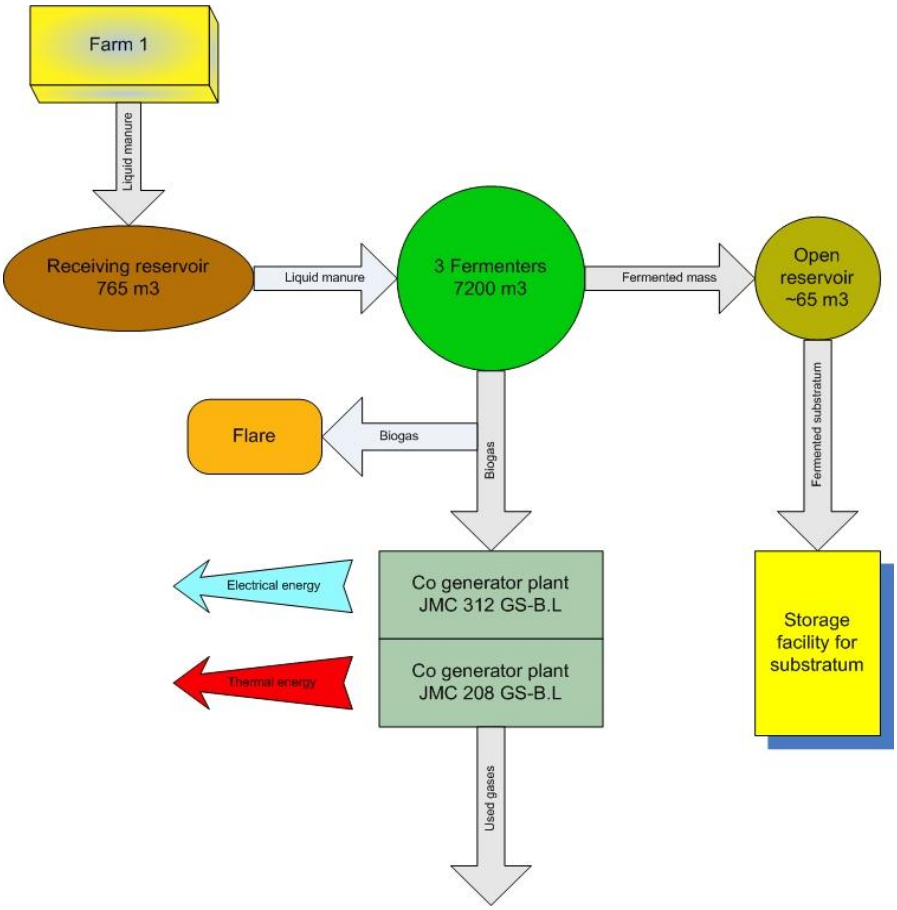
- clay sand loess soil slightly wet at the depth of 3 m;
- clay sand loess soil plastic at the depth of 6 m.

Sod soil layer is presented by taupe humus clay sand with capacity 0,3-0,9 m.
Construction of the biogas plant is carried out in compliance with construction, ecological, health standards and regulations in force as of 01.02.2008, following explosion and fire safety requirements and guarantee safe for people operation of the object. Below there is given a list of documents received as a result of the project object complex expertise:

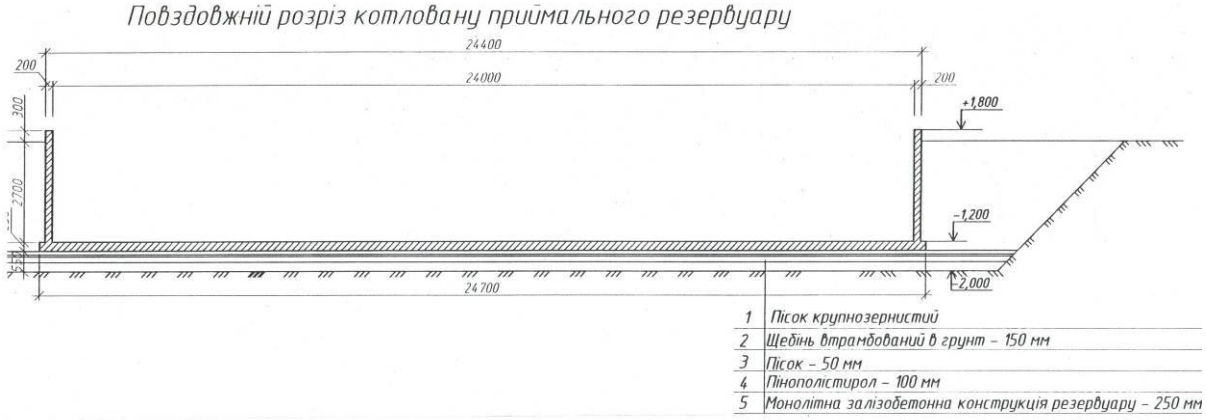
- conclusion of the complex state expertise made by the state enterprise "Ukrderzhbudekspertyza" #85/08 of 14 July 2008;
- conclusion of the expertise made by the state enterprise "Kyiv expertise and technical center of the national scientific and research institute of industrial safety and protection of labor" 08B #04-2120-13841 of 12 June 2008;
- conclusion of the expertise made by the state enterprise "Kyiv expertise and technical center of the national scientific and research institute of industrial safety and protection of labor" 08B #04-1123-13982 of 16 October 2008;
- expertise conclusion made by the Department of regulatory and technical work and licensing of Ministry of Extraordinary Situations Main Directorate in Kyiv oblast #9/6/4039 of 03 July 2008;
- expertise conclusion made by the Department of regulatory and technical work and licensing of Ministry of Extraordinary Situations Main Directorate in Kyiv oblast #9/6/5666 of 11 September 2008;
- technical requirements as to energy conservation submitted by the Territorial Department of the State Inspection on energy conservation in Kyiv oblast and Kyiv #07/18-1/681 of 24 September 2008;
- expertise conclusion made by the Territorial Department of the State Inspection on energy conservation in Kyiv oblast and Kyiv #08/P/18-1/251 of 10 October 2008;

- conclusion made by the State Department for Protection of Environment in Kyiv oblast #06-12/3179 of 14 July 2008;
- conclusion made by the Kyiv oblast sanitary and epidemiologic station #03/03-04-10-432 of 13 May 2008;
- conclusion made by the State sanitary and epidemiologic department #05.03.02-07/4041 of 30 January 2008;
- scientific conclusion made by the State Department "Institute of hygiene and medical ecology named after O.M. Marzeev of the Ukrainian Academy of Medical Sciences" #22.2/354 of 28 January 2008;
- conclusion made by the State sanitary and epidemiologic expertise of the Ukrainian Ministry of Health Care #05.03.02-04/54626 of 27 August 2008.

All conclusions mentioned above are positive.
The principle of the biogas plant operation is given in picture 8.
Liquid manure (moisture is about 93%) from the farm cattle premises under pressure is pumped through the pipeline to the receiving reservoir (picture 9), where the mass is stored for a definite time with simultaneous heating and mixing.



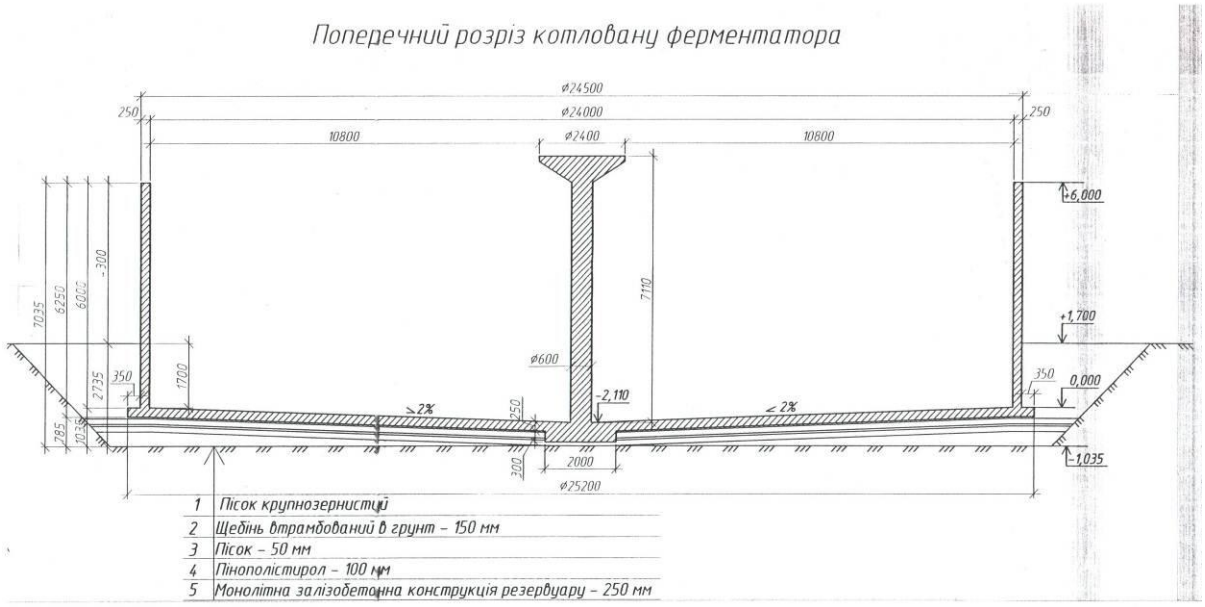
Picture 8. Biogas plant principle scheme at Farm 1.



1. Coarse-grained sand
2. Crushed stone rammed into soil – 150 mm
3. Sand – 50 mm
4. Cellular polystyrene - 100 mm
5. The reservoir reinforced ferroconcrete construction – 250 mm

Picture 9. View in longitudinal section of the receiving tank foundation ditch.

The receiving reservoir has an oval shape (the tank capacity is 765 m^3, height – 3 m, inner width – 24 m). The tank is made of a reinforced concrete on sulphate-resistant cement with the side thickness 0,2 m, immersed for 2,7 m into the land. From the outside the sides are isolated by the two layers of damp course and have variable height depending on the level of filling, inside they are protected from corrosion with special foam that is stuck on mastic and has variable height depending on the level of filling. The tank bottom and sides have a built-in heating system and heating insulation. For protection heating insulation system from negative affect of environment the sides have a metal trimming. The receiving tank has a reinforced ferro-concrete plate 0,18 m thick as its cover. The plate reduces losses of heat and biogas from the tank. Inside there are two hydrokinetic mixers that are put into manure mass to mix substance with the aim of its homogenization. The tank is cleaned from remnants of manure and insoluble elements by their pumping with the help of vacuum tun 8-48 times per day. From the receiving tank manure is transported under pressure to the fermenter via the pipe system (picture 10). The storage time for manure in receiving tank is less than 24 hours.
In total the biogas plant project foresees three fermenters. A fermenter in a round tank shape, fossil into soil for 1,7 m, with the inner diameter 24 m and inner height 6 m. The fermenter operates in a flowing regime under mesophilic conditions (temperature 34-37°C). The hydraulic retention time for manure in a fermenter is 25-30 days. The fermenter has the using capacity 2400 $м^3$, made of reinforced ferro-concrete on a sulphate-resistant cement with the side and bottom width 0,25 м. In the middle of the fermenter there is a column with a cap. The fermenter's overlap is made in a form of a wooden deck, the bottom has 2% tilting about the center for lightening the process of mixing and biomass removal. Manure unloading from fermentation camera is carried out via a pipe line that is mounted in the tank bottom. Under the fermenter's bottom a drain circular system on the basis of a perforate pipe is installed for removal underground waters. For avoiding appearance of crust on the fermented substance surface, two four-spade mixers under the definite slope angle are installed in every fermenter (picture 11).



1. Coarse-grained sand
2. Crushed stone rammed into soil – 150 mm
3. Sand – 50 mm
4. Cellular polystyrene - 100 mm
5. The reservoir reinforced ferroconcrete construction – 250 mm

Picture 10. The fermenter ditch cross section.

Picture 11. Equipment for mixing manure during their fermentation in a fermenter (construction site: Kyiv oblast, Zgurivsky region, v. Velyky Krupil).

The substance is supplied to the fermenter in equal portions during a day, ensuring in this way stable biogas production. A camera for biogas accumulation (gas-holder) is located over the deck in the tank for fermentation.

Gas-holder is a rubber cupola for accumulation of produced biogas. The pressure inside the gas-holder is from 2000 to 5000 kPa. Biogas supply to the gas-holder from the fermentation tank is carried out through a ring whole in the fermenter's deck. A resistant cupola is installed externally to protect a rubber one. The safety of the gas-holder operation is guaranteed by installation of a subsidiary channel of a super high and super low pressure.
Biogas produced in the fermenter has the following gas composition:

- methane– 55-75%;
- carbon dioxide – 21-41%;
- nitrogen – 1-3%;
- hydrogen – 0,01-0,03%;
- hydrogen sulphide – 0-3%.

Biogas calorific value is 5000-6500 Kcal/m^3.
Being purified from hydrogen sulphide with the help of sulfur removal system, biogas produced in the fermenter, goes into cogeneration units under stable pressure.
Cogeneration units convert biogas energy into electrical and thermal energy with the help of generators that are started by internal-combustion engines.
The main parameters of cogeneration units are given in Table 1 and Table 2.

Table 1. – Parameters of cogeneration units.

Index	**Cogeneration unit (1) JMC 208 GS-B.L**	**Cogeneration unit (2) JMC 312 GS-B.L**
Electric power, kW	330	625
Heating capacity, kW	395	686
Gas spending Nm^3/h	170	313

Table 2. – Parameters of cogeneration units.

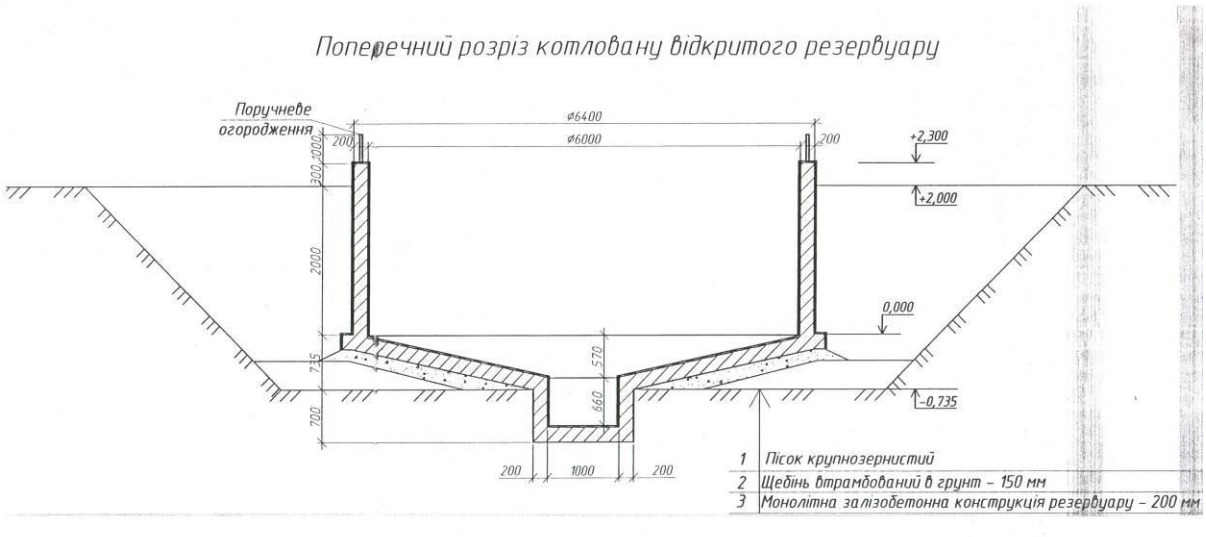
Index	**Generator (1)**	**Generator (2)**
Current frequency, Hz	50	50
Number of phases	Three	Three
Pressure, V	400	400
Level of protection	IP 23	IP 23
Level of insulation	H	H
Level of heating under loading	F	F
Length, m	12,2	12,2
Width, m	2,5	2,5
Height, m	2,6	2,6
Working mass, kg	18 000	20 800

Wires for electric power supply are joined to the cogeneration unit electrical compartment. The installed capacity of electrical equipment for both farms of UDC is more then electrical capacity of installed within the project co generators (for example for Farm 1 the installed capacity of electrical equipment amounts to 1,3 MW, co generators - 0,955 MW). This information confirms the fact that the electricity will be consumed only for own needs of farms and will not be soled.
Heat medium with the temperature about 90°C is supplied via pipeline system for heating, first of all substance in the fermenter and receiving tank, remnants of heating are used for the farm technological needs. Heating supply system is equipped with a circular pump, thermoregulator and membranous tank for compensation of water thermal expansion. In the event of temporal cogeneration break biogas is supplied to a flare facility where it is burnt.

Flare facility is aimed to constant or periodical biogas burning due to impossibility of its utilization in cogeneration.
The facility is composed from:

- flare candle for biogas burning;
- service place;
- column;
- fire barrier;
- gas pipe-line system;
- automatic equipment system.

Flare candle is supplied with a regulatory facility that protects fire separation, remote control firing and protection from wind facility (two electrical and gas lighters with the systems of biogas supply and energy consumption). Using of electrical and gas lighters guarantees reliability of biogas burning in the frame of possible changes in its composition.
Fire barrier is mounted in a pipeline system that supplies biogas. Its aim is to prevent fire penetration into the pipeline from a flare candle in case of increasing oxygen concentration in biogas. Automatic equipment system guarantees safe and reliable firing of a flare facility. Automatic equipment is realized on the basis of elements produced commercially.
Flare facility producer for the given project is Gas Institute of the National Academy of Sciences of Ukraine. The choice of a producer was done on the basis of the fact that as of today the Gas Institute is the only one organization in Ukraine that has accredited laboratory for carrying out tests with flare candles. Flare candle is delivered with all necessary certificates required by the State Commission.
After fermenters manure goes to an open reservoir for further storage (picture 12).



1. Coarse-grained sand
2. Crushed stone rammed into soil – 150 mm
3. The reservoir reinforced ferroconcrete construction – 200 mm

Picture 12. Cross section of an open reservoir ditch.

The open reservoir is located between the fermenters with capacity 64,99 m^3, inner diameter – 6 m, height – 2,3 m. From the open reservoir manure goes to the storage facility for substratum.
Biogas plant gas network is designed on the basis of gas usage that constitute 11 800 m^3/day. Gas network consists of the underground gas pipeline system (supply biogas from a fermenter to cogeneration units), subsidiary units (are installed on the fermenter and prevent from appearance of super high and super low pressure in gas-holders and pipelines), condensate receiver and flare unit.
Location of fermenters and other facilities on the enterprise plan (picture 13) meet the requirements of Construction norms and regulations (СНиП) II-89-80 “General plans for industrial enterprises”,

Construction norms and regulations 2.04.08-87 "Gas Supply" and Technological Designing Departmental Regulations of Agro-Industrial Complex (ВНТП-АПК) 09.06 "Systems of manure removal, treatment, preparation and usage".

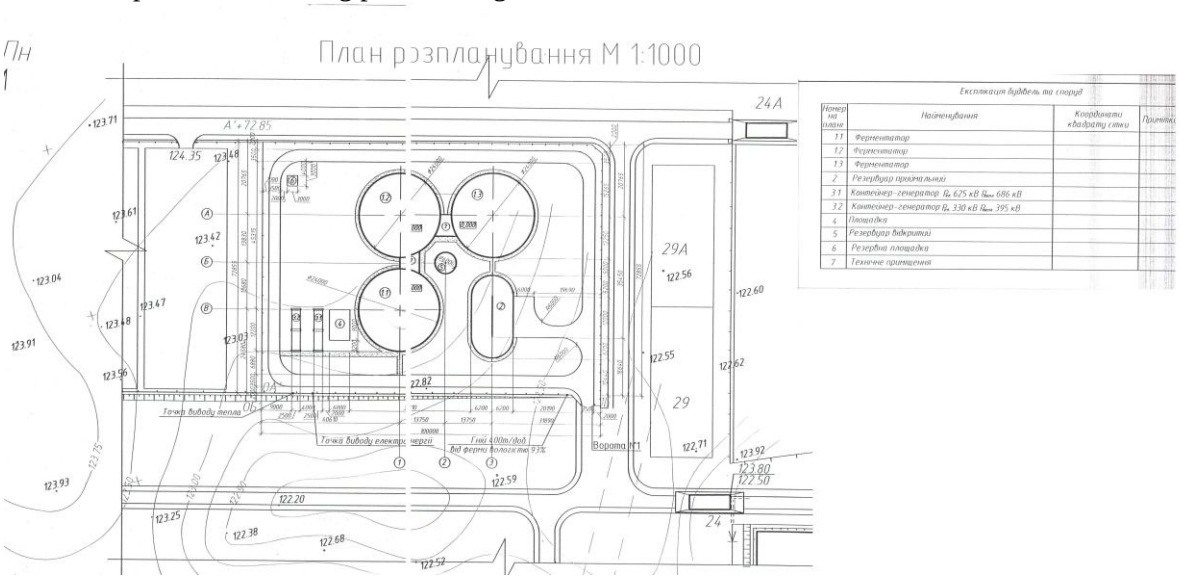
The biogas plant operators are trained by the specialists of company ZORG-UKRAINE Ltd. on the following issues:

- biogas plant operation;
- failure recovery;
- energy safety;
- using of fermented fertilizers for agricultural needs.

Before operating biogas plant the personnel will study standards of safety regulations at enterprises – "Regulations for labor safety in agricultural production" (НПАОП 01.1-1.01-00, ДНАОП 2.0.00-1.01.-00), as well as safety regulations in gas plant operation.

Operators will work all day round seven days a week and 365 days a year.

The list of personnel working per shift is given in Table 3.



1.1 Fermenter
1.2 Fermenter
1.3 Fermenter
2 Receiving reservoir
3.1 Co generator plant with capacity 625 and 686 kW of electrical and thermal energy correspondingly
3.2 Co generator plant with capacity 330 and 395 kW of electrical and thermal energy correspondingly
4. Site
5. Open reservoir
6. Reserve site
7. Technical premise

Picture 13. General layout for location of biogas plant at Farm 1.

Table 3. –Personnel working per shift.

Job	**Group of industrial procedures**	**Number of workers person/shift**
Senior operator	1-B	1
Operator on duty	1-B	0,66
Chemist-laboratory assistant	1-B	1
Total		*2,66*

Social-economic effect from gas plants implementation is determined by the following factors:

- reduction of national economy dependence on energy carriers import and increase of the country's energy safety level;
- solution of problems of stable energy resources supply to agricultural sector of economy by using own source of renewed energy with high ecological and technical indicators of its consumption;
- high indicators of labor and health care;
- using of organic wastes in the agricultural enterprises territory;
- energy safety at the expense of substitution of energy from the net by the energy produced from alternative sources;
- improvement of global ecological situation (counter action to global climate changes by reduction of methane and carbonic dioxide emissions in atmosphere);
- production of high quality organic fertilizers free from helminthes eggs, weed seeds and nitrates;
- creation of jobs during biogas plants assembly and construction and in the process of their operation (3-4 specialists for every unit).

Biogas plant at the farm in Chernigiv oblast, Borzniansky region, v. Komarivka.

Biogas plant at Farm 2 will be set into operation in 2010. According to the general contractor contract (#212 of 16.06.08) with the construction company "Ukrbudinvest" Ltd. nowadays at the construction site of a dairy farm complex assembly and construction works are taking place (picture 14).

Besides, between Ukrainian Dairy Company Ltd. and companies-representatives from Hungary and Germany the agreement has been signed for delivery of milk herd cows of Holstein breed (at Farm 1 there are cows of the same breed).

Data as to gas plant components are provided in Table 4.

Picture 14. Building and assembly jobs on the farm construction site in Chernigiv oblast, Borzniansky region, v. Komarivka.

Table 4. – Components of biogas plant at Farm 2.

Index	Technical characteristics	Quantity
Preliminary fermentation tank	Receiving reservoir: 1 525 m^3, height 3 m, width 24x48 m	1
Main digester	Fermenter: 2 400 m^3, diameter 24 m, height 6 m	6
Lagoon for after fermentation	25 000 m^3	5
Gas purification system	Pressure 20-50 mBar, temperature 8-10 ºC, pipeline length 50 m, depth 1,2 m, hydrogen sulphide content – less than 0,2%	1
Flare facility	Flare candle: Pressure from 50 mBar, biogas incineration 300-400 m^3/hour	2
Thermal power generator	Cogeneration unit JMC 312Gs-B.L of 526 kWh of electric and 566 kWh of thermal power	3

In startup period that amounts to 60 days definite amount of electricity from the grid is consumed.
Amount of electricity from the grid that will be used to power auxiliary equipment (engines of pumps and mixers, initial heating of fermenters) at farm 1 makes up 292,8 MWh. Quantity of electricity consumed from the grid at farm 2 was calculated on the basis on assumption. It was assumed that amount of electricity from the grid at Farm 1 is in direct proportion to useful capacity of fermenters (7200 m^3 at Farm 1 and 14400 m^3 at Farm 2). Consequently, estimated quantity of electricity consumed to power auxiliary equipment of biogas plant at Farm 2 constitutes 585,6 MWh.
In emergency conditions it is envisaged that co generators will be functioning on diesel fuel. It was assumed that quantity of diesel consumed at Farm 1 (0,413 t/day) is in direct proportion to installed electrical and heat capacity of co generators (2,0 and 3,3 MW at Farms 1 and 2 correspondingly). Resulting amount of diesel consumed makes up 0,681 t/day.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

At the absence of the project livestock manure would be stored in anaerobic lagoons (this method of managing manure is economically reasonable and meet requirements of the Technological Designing Departmental Regulations of Agro-Industrial Complex[7]) that would lead to methane emission directly to atmosphere. Methane emissions reduction, according to the project, will be achieved due to biogas capturing and its further combustion in a cogeneration unit.
In addition emission reduction of another greenhouse gas – CO_2 will be achieved, as production of electrical and heating energy from the renewable sources (biogas) will lead to substitution of the equivalent amount of energy produced in the result of combustion of fossil fuels at power stations, which supply power to energy system.
There are a number of obstacles that make it difficult to implement biogas projects if they are not registered as JI projects (detailed additionality analysis is given in chapter B.2).

A.4.3.1. Estimated amount of emission reductions over the crediting period:

[7] Technological Designing Departmental Regulations of Agro-Industrial Complex (ВНТП-АПК) 09.06 "Systems of manure removal, treatment, preparation and usage", Kyiv-2006, AIC Ukraine.

Year	Annual calculation of the volume of GHG emission reduction in tons CO_2-eq.
2009	2 942
2010	61 571
2011	69 386
2012	69 386
Aggregate calculated volume emission reduction during crediting period (t CO_2-eq.)	203 286
Annual calculated volume emission reduction during crediting period (t CO_2-eq.)	50 822

A.5. Project approval by the Parties involved:

National Environmental Investments Agency (NEIA) as an official and authorized representative of Ukraine considered the project "Biogas utilization for generating of electricity and heat at the farms of Ukrainian Dairy Company Ltd." and submitted a letter of endorsement (of 31.10.2008 #903/23/7).

Pursuant to the regulatory and legal acts that set requirements to preparation of JI projects, the following documents will be submitted to NEIA to receive a letter of approval:

- letter of request for issuing a letter of approval;
- copy of the letter of endorsement;
- conclusion of an independent expert organization;
- project design documentation.

Pursuant to the Ukrainian regulations, a letter of approval is being issued within 30 days upon the receipt of the above stated documents.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

The requirements mentioned in paragraph 45 of the resolution 3/CMP.1 (FCCC/KP/CMP/2005/8/Add.1) were taken into account while determining the baseline scenario. In particular, baseline was estimated:

- by the project participants pursuant to the instructions as to application of both approved and new methods, stated in the resolutions 17/CP.7 (FCCC/CP/2001/13/Add.2), 1/CMP.2 (FCCC/KP/CMP/2006/10/Add.1), as well as taking into account the criteria for the baseline setting, stated in items 1-3 of the Appendix B to the resolution 9/CMP.1 «Guidance on performing article 6 of the Kyoto Protocol» and in «Guidance on criteria for baseline setting and monitoring»[8];
- taking into account transparency and conservativeness requirements as to the selection of approaches, assumptions, methodologies, parameters, data sources, principles of the project additionality determination as well as taking into account uncertainties;
- taking into account specific conditions typical for this project;
- pursuant to the simplified procedures, specified in the methodologies for the baseline setting and monitoring;
- taking into account the national policy as well as circumstances, such as implementation of reforms in the agrarian sector, strategic plans as to the energy sector development as well as the economic situation in AIC.

[8] Guidance on criteria for baseline setting and monitoring, version 01 (Joint Implementation Supervisory Committee).

The proposed JI project foresees 2 components (III.D and I.C). The following methods, adopted by the CDM Executive Board of the UNFCCC, were applied to determine the baseline emissions:

- AMS-III.D. "Methane recovery in agricultural and agro industrial activities", version 15;
- AMS-I.C. "Thermal energy for the user with or without electricity", version 13.

Choice of above mentioned methodologies is based on the fact that emission reductions from all type III.D components is less than 60000 t CO_2-eq. (for the period 2009-2012 are in the range of 316-31540 t CO_2-eq.) and thermal energy production capacity from all type I.C components (co generators at Farms 1 and 2) is less than 45 MW (see tables 1 and 4) that is in compliance with applicability requirements for such methods.

The first component (methodology AMS-III.D) foresees that in the absence of the project manure from the farms would be washed down to anaerobic lagoons as transition to other manure management systems is economically unreasonable for the project owner – Ukrainian Dairy Company Ltd. At the same time, as a result of manure keeping in anaerobic conditions in lagoons methane would be generated. According to the second component (methodology AMS-I.C) electric energy would be supplied to the Farms 1 and 2 by CJSC Kyivoblenergo and JSC Chernigivoblenergo. Carbon dioxide would be emitted to the atmosphere as a result of fossil fuel combustion at the thermoelectric power station.

The proposed JI project meets all following requirements as to the baseline scenario, specified in the methodologies AMS-III.D and AMS-I.C:

- according to EIA milk herd cows are kept in closed premises;
- manure, removed from cattle premises, does not get to natural reservoirs (river, lake etc.) as unapproved discharge and disposal of wastes within the boundaries of water protection zones and zones of sanitary conservation as well as in other places that could lead to danger for the environment and people health is prohibited according to Ukrainian legislation (the Law of Ukraine "On Wastes" of 05.03.1998 #187/98-BP, article 33). In any case, Farms of Ukrainian Diary Company Ltd. are situated within the normative limits from lakes and rivers as well as water protection zones and zones of sanitary conservation;
- average annual temperatures in the regions, where the project objects are located (Kyiv and Chernigiv oblasts) are higher than 5°C (Annex 2, table A2.1);
- in accordance with Technological Designing Departmental Regulations of Agro-Industrial Complex manure is stored in anaerobic lagoons within the period more than a month, lagoons' depth is more than 1 m;
- according to the baseline methane as a component of biogas is not a subject for utilization (combustion on flare, production of electrical and heating energy in cogeneration unit, etc.).

B.2. Description of how anthropogenic emissions of greenhouse gases by sources are reduced below those that would occurred in the absence of the JI project:

Analysis of the project additionality was conducted on the basis of methodological "Tool for the demonstration and assessment of additionality" (version 05.2).

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-Step 1a. Defining alternatives for project activity

Based on technological and economical analysis of possible ways of manure utilisation with heat and power generation, the following scenarios save the project activity were identified:

Scenario 1 – construction and putting into operation biogas plants at two dairy farms with heat and power generation for farms own needs without JI benefits.

There is no legal requirement to implement the project activity, though this alternative is in compliance with all applicable legal and regulatory requirements. However, this alternative has very strong investment barrier (See Step 2).

Scenario 2 – Import of electricity from the grid (the manure management systems without changes).

In the absence of JI project activity, UDC needs to import the necessary electricity to operate the farms from national grid of Ukraine. This would result in an equivalent amount of GHG emissions from the fossil fuel combustion power plants serving to the grid.
Scenario 2 is common use practice in the home agricultural industry. The advantages of the scenario 2 are:

- it does not require any additional expenses;
- it does not carry any risks caused by implementation and usage of the complex technological equipment.

Since this situation is in the status quo in Ukraine, Scenario 2 is further considered as the baseline scenario.

Sub-step 1b. Compliance with mandatory laws and regulations

Alternatives that were reviewed above are in compliance with existing laws.
The project is not in conflict with regulations of the current regulatory legal acts in the area of environmental protection (the Law of Ukraine "On the Protection of Environment" of 25.06.1991 #1264-XII, the Law of Ukraine "On Wastes" of 05.03.1998 #187/98-BP, the Law of Ukraine "On Alternative Sources of Energy" of 20.02.2003 #555-IV and the Law of Ukraine "On air protection" of 16.10.92 #2708-XII). At the same time no one of above mentioned laws have obligations regarding compulsory implementation of proposed project activity.

Step 2. Investment Analysis

According to Methodological "Tool for the demonstration and assessment of additionality" the Analysis is conducted to determine whether the proposed project activity is not:

- financially attractive; or
- financially feasible without the revenue from sale of emission reduction units.

Sub-Step 2a. Determintation appropriate analysis method

Investment analysis was undertaken in accordance with Annex to methodological "Tool for the demonstration and assessment of additionality" (Guidance on the assessment of the Investment Analysis, version 02). The aim was to determine whether or not the proposed JI project is economically or financially feasible without the revenue from the sale of ERUs.
The proposed project activity generates financial benefits other than JI related income (revenues from electricity displacement from the grid) and therefore the simple cost analysis (Option I) can not be applied. Option II (investment comparison analysis) can not be used as obtaining of financial indicators such as IRR and NPV for similar projects is impossible (the proposed project is the first of its kind). So benchmark analysis (Option III) that considers economic and financial contexts in Ukraine at the moment of investment decision-making was applied to test the financial additionality of the project.

Sub-step 2b. – Option 1. Simple expense analysis

Not applicable

Sub-step 2b. – Option II. Comparative analysis of investments

Not applicable

Sub-step 2b. – Option III. Apply benchmark analysis

Credit resources in Ukraine are very scarce regarding capacity and financial conditions. Projects for financing are selected on the principle of the least expenses. According to National Bank data[9] loan interest rate in real economics sector at the moment of investment decision-making (27th of December 2007) amounted to 15,3% in national currency and 11,2% in foreign currency. Attracted deposits rate for long-term period was 10,9% in UAH and 7,1% in foreign currency. Capital investments in replacement of an organic waste treatment system will not comply with the least expenses criteria. That is why the chance of attracting financial flows in such project is minimal. Cost of project to be implemented at the farms of the Ukrainian Dairy Company Ltd. is

[9] http://www.bank.gov.ua/STATIST/DAILY/2009/Procentlastb_2009.htm

comparatively small. Therefore this project will not attract investments of country's biggest financial institutions.
The discount rate used for comparison analysis of investment projects in Ukraine, was chosen as benchmark for comparison with Internal Rate of Return (IRR) for the proposed project with and without involving JI mechanism. Considering Ukrainian bank loan rates for businesses and other materials for the moment of investment decision the selected discount rate is 16,1% .
The period of NPV and IRR assessment is not limited to the proposed crediting period (2009-2012) of the project activity and reflect the period of technical lifetime of biogas plants as a whole (15 years). In accordance with official data from company-supplier of equipment technical lifetime of co generators consisting of biogas plants amounts to 60000 hours (7,5 years). In connection with this, cost of co generators major repairs was included in financial analysis. For Farm 1 the overhaul is planned in 2016, for Farm 2 - in 2017 (financial expenditures will constitute 730000 and 1570000 EUR correspondingly). Repairs will be carried out by the representatives of authorized affiliate of GE Jenbacher in Ukraine - Company Sinaps directly at project site.
As biogas plant is an integral complex, exploitation of it's separate parts after the end of technical life time is not possible. It is expected that in 2023 the residual value of biogas equipment at Farms 1 and 2 will be equal to the cost of metal constructions (scrap metal). Cost of scrap metal at Ukrainian home market on the moment of Investment decision-making (December 2007) amounted to 188 EUR/t.[10] Weight of biogas plants metal constructions (co generators, pumps and mixers) at both Farms constitutes 135 t. Residual value of assets calculated based on above mentioned values makes up 25 thousand EUR. The residual value of concrete constructions of the biogas plant was accepted as zero taking into account impossibility of prolongation of their usage behind 15 years long period assessment. Below presented options of depreciated fermenters usage as well as barriers for their realization were analyzed:

Option #	Description	Explanation
1	to disassemble, replace and sell to other company for biogas plant or other needs	Fermenters are made of reinforced concrete on the base of sulfate-resistant cement with a wall thickness of 0,2 m and it is digged into the ground on 2,7 m. The main disadvantage of this part of biogas plant - it is fundamental building of very specific design. It is impossible to disassemble and move fermenters without complete loss of its functionality. Accordingly, it is impossible to sell used fermenters without part of the Farm land selling; the banks don't accept such a construction as collateral when granting loans.
2	to use for other own needs	It should be noted that destructive processes which reduce the carrying capacity and reliability of reinforced concrete foundations and structures such as fermenter during the term of exploitation have the multiparameters character: this is the impact of soil and climatic factors of the environment and the influence of vibrations from the action of wind loads and other specific (eg, biochemical) operational conditions of reservoirs for manure digestion. The used fermenters after 15 years of intensive operation are to be a subject to specific diagnosis before decision making as for its possible application as a fundament of some new construction for own needs of the Farm. This specific diagnosis includes a survey of technical and corrosion condition of reinforced concrete structures by means of ultrasonic methods for determining the strength of concrete, vibration methods for

[10] http://www.ruslom.ru/?page=analytics_20032008_pr

		evaluating the mechanical properties of reinforced concrete fermenters, as well as electrochemical methods for determining the corrosion status of reinforcement and the bare metal, located in the ground. Application of ultrasonic methods for assessing the strength of concrete is based on the existence of a stable dependence of the parameters of ultrasonic vibration in the concrete on the condition of the structure, the availability and accumulation in it of any defects or damage. With the advent of these defects decreases the strength of concrete and appropriately varies the speed (time) ultrasound propagation in concrete. The investigations of these parameters have high cost and expertise conclusion as for applicability of these parameters levels for usage in new construction will be costly taking into account high probability of negative result obtaining. There is no need to use fermenters as manure storages because the Farms have sufficient quantity of special designed in accordance with Ukrainian norms lagoons for manure storage. The used reservoirs for manure digestion could not be also used as reservoirs for fodder from sanitation point of view.

The possible selling price of the rest of non-metallic parts does not exceed additional disassembling expenditures (not included in project costs). Thus the residual value of these parts is equal to zero too.

Depreciation values for the 2009-2023 were calculated based on linear approach by dividing of capital investment costs on lifetime project period. The depreciation has been only taken into account for the calculation of the taxes and is not included in the cash flow. In particular, depreciation has been deducted in estimating gross profits on which tax is calculated. Gross profit for each year of the assessment period was estimated by deducting of operational and depreciation costs from total project benefits (in 2009 gross profit is negative and therefore tax for this year was not considered). In accordance with Ukrainian legislation 25% of tax was charged on gross profit for the period 2010-2023.[11] Net profits (with taxes) were estimated by deducting of tax in EUR from cash flow (without taxes). NPV and IRR indicators were calculated on the basis of net profits. Discount rate represents the expected rate of income on laid-down capital in investment objects with comparable risk levels was calculated using methodology described in scientific article. Methodology that is given below is supposed to be the most favorable in Ukrainian conditions[12].

For calculation of discount rate the following equation was applied:

$$I = R_{\text{inf}} + G, \qquad (1)$$

where:

I - discount rate;

R_{inf} - return on capital without risk (including inflation processes), fraction;

G - risk rate.

Value of return of capital without risk as a rule is determined based on income rates on long-term governmental bonds. This choice is caused by the fact that governmental bonds are characterized by

[11] The Law of Ukraine "On enterprises profit taxation" #335/94 of 28.12.94, article 10.

[12] Kotova M.V., Shapoval S.S. Grounding of the method of calculations the discount rate in domestic practice. – Economichny prostir. - 2009. №22/1, p. 92-98.

very low risk associated with insolvency and high level of liquidity. Long-term bonds are used to ensure the possibility of comparison with investments in equity capital that usually are carried out by investors on analogous time period. But considering the current situation at Ukrainian market, long-term public bonds don't reflect the real return on capital with minimal risk and are connected rather with political than economical factors. Therefore, average statistical reporting data of Ukrainian banks on currency deposits at the moment of investment decision-making (27th of December 2007) that constitute 7,1%[13] were used as R_{inf} value.

In risk rate (G) usually the following risks are considered: insufficient diversification of production; insufficient diversification of market, size of enterprise (investment risks into the small enterprises), country risk, and insufficient information about perspectives of project realization.
In accordance with the study[14] the risk rate or premium for risk consists of two components – the risk of investing in region or sector of economy and the risk of investing in a company (enterprise).
The first type of risk can be identified only by means of expert assessment method. The risk rate 5% is used for it. It reflects risk of investing into Ukraine, agricultural sector and includes the following factors[14]. According to numerous international studies major obstacles to innovation activities in Ukraine are:

- instability and complexity of public administration;
- uncertainty of economic environment;
- uncertainty in the law;
- high level of corruption;
- tax burden;
- problems with VAT refunds.

The rate value for the second type of risk is the middle of the range of 3-5 %[15]. Discount rate I calculated on the basis of equation 1 that include both risk types amounts to 16,1%.
According to the "Guidance on the assessment of the Investment Analysis"[16] loan repayment was not included in the calculation of project IRR.
Project benefits include revenues from electricity displacement and selling of ERUs. Average data about amount and cost (in UAH) of electricity consumed at Farm 1 for the period January-March 2008 (inquiry #773 of 11.12.2008) were used as electricity price (to convert UAH to EUR exchange rate 7,52 were used). This value was calculated as simple average between National Bank data about currency exchange at the beginning of January, February and March 2008.[17] Resulting electricity price derived based on average data constitutes 44,52 EUR/MWh. ERUs price at the rate of 14 EUR/t CO_2-eq. was assumed.
Input data for proposed JI project investment analysis are given in tables 5-6.

[13] http://www.bank.gov.ua/STATIST/DAILY/2009/Procentlastb_2009.htm

[14] Doing business with Ukraine, Global market briefings. Third edition. Consultant editor Dr. Marat Terterov.

[15] Kotova M.V., Shapoval S.S. Grounding of the method of calculations the discount rate in domestic practice. – Economichny prostir. - 2009. №22/1, table 1.

[16] "Guidance on the assessment of the Investment Analysis", version 02.

[17] http://www.bank.gov.ua/KURS/last_kurs1.htm

Table 5. – Net cash flow of the project with taking into account selling of ERUs, EUR.

Year	Capex	Opex	Revenues from electricity displacement	Revenues from ERUs selling	Depreciation	Taxation	Residual value	Net cash flow
2008	-7 560 000,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2009	0,0	- 105 000,0	130 516,6	41 194,7	504 000,0	0,0	0,0	-7 493 288,7
2010	0,0	- 105 000,0	1 781 888,8	861 996,1	504 000,0	561 221,2	0,0	1 977 663,7
2011	0,0	- 105 000,0	1 880 586,8	971 409,7	504 000,0	613 249,1	0,0	2 133 747,4
2012	0,0	- 105 000,0	1 880 586,8	971 409,7	504 000,0	613 249,1	0,0	2 133 747,4
2013	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2014	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2015	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2016	0,0	- 730 000,0	1 880 586,8	0,0	504 000,0	526 646,7	0,0	623 940,1
2017	0,0	- 1 570 000,0	1 880 586,8	0,0	504 000,0	736 646,7	0,0	-426 059,9
2018	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2019	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2020	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2021	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2022	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	0,0	1 405 190,1
2023	0,0	- 105 000,0	1 880 586,8	0,0	504 000,0	370 396,7	25 314,0	1 430 504,1

Table 6. – Net cash flow of the project without taking into account selling of ERUs, EUR.

Year	Capex	Opex	Revenues from electricity displacement	Depreciation	Taxation	Residual value	Net cash flow
2008	-7 560 000,0	0,0	0,0	0,0	0,0	0,0	0,0
2009	0,0	- 105 000,0	130 516,6	504 000,0	0,0	0,0	-7 534 483,4
2010	0,0	- 105 000,0	1 781 888,8	504 000,0	345 722,2	0,0	1 331 166,6
2011	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2012	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2013	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2014	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2015	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2016	0,0	- 730 000,0	1 880 586,8	504 000,0	526 646,7	0,0	623 940,1
2017	0,0	- 1 570 000,0	1 880 586,8	504 000,0	736 646,7	0,0	-426 059,9
2018	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2019	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2020	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2021	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2022	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	0,0	1 405 190,1
2023	0,0	- 105 000,0	1 880 586,8	504 000,0	370 396,7	25 314,0	1 430 504,1

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to Options II and III):

Results of financial indicators (IRR and NPV) estimation are shown in Table7.

Table 7. – Financial indicators, including and excluding selling of ERUs.

Index	**With selling of ERUs**	**Without selling of ERUs**
Implied discount rate, %	16,1	16,1
IRR, %	19,0	13,7
NPV, EUR	712 986,6	-668 662,7

Sub-step 2d. Sensitivity analysis (only applicable to Options II and III):

Electricity cost, Capital expenditures (Capex) and operational expenditures (Opex) were a subject to reasonable variation. Sensitivity analysis covered a range of +10% and -10% for the project lifetime period.

The results of sensitivity analysis are shown in Table 8.

Table 8. – Results of sensitivity analysis.

Index	**IRR,%**		**NPV, EUR**	
	With selling of ERUs	**Without selling of ERUs**	**With selling of ERUs**	**Without selling of ERUs**
Electricity cost +10%	21,6	16,1	1 379 966,3	-1 683,0
Electricity cost -10%	16,3	11,1	46 007,0	-1 335 642,3
Capex +10%	19,0	11,9	787 873,7	-1 260 755,3
Capex -10%	19,0	15,8	638 099,6	-76 570,0
Opex +10%	18,4	13,1	570 963,6	-810 685,7
Opex -10%	19,5	14,2	855 009,7	-526 639,6

Analyses of Tables 5-8 makes it's possible to draw a conclusion that the suggested JI project becomes financially attractive for its owner only under condition of selling a definite amount of ERUs, as:

- size of IRR is higher then a coefficient fixed in discount calculations that equals 16,1% and size of NPV is positive only with consideration of revenues from ERUs selling;
- with electricity cost 49,0 EUR/MWh (+10%) and 40,1 EUR/ MWh (-10%) as well as Capex and Opex +/-10% for the period 2009-2023 NPV is positive and IRR is bigger than assumed discount rate only with selling of ERUs.

Hence we proceed to Step 4.

Step 3: Barrier analysis

Not applicable.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

Technological designing departmental regulations of Agro-Industrial Complex should be used while projecting systems of manure removal, treatment, preparation and usage in Ukraine. According to the norms choice of systems need to be performed based on technological and economic comparison of variants, taking into account specialization and dimension-types of enterprises, method of stock keeping, availability of sufficient areas of irrigated fields, climatic, soil and hidrogeological conditions and relief as well as requirements on environment protection. Manure that is removed from livestock premises have to be stored in anaerobic lagoons for 6 months in case of dairy farms or 12 months in case of swine farms. Besides, bottom of lagoons should be paved with material that prevents from manure penetration to the ground waters. Farm owners, that have waste management systems complying with mentioned requirements, including UDC do not have any incentives for changing of current practice, as there is no legislation that regulates GHG emissions from waste management systems in Ukraine. Hence, without

financial instruments of Kyoto protocol, farmers, including UDC, will not change common practice of manure storage in lagoons.

In Austria federal agricultural organisations and banks provide financial support to the biogas projects. Denmark government subsidises biogas projects (20% from construction estimate). In case Ukraine will have governmental subsidising or financial support from banks and other institutions, biogas projects will become profitable even without revenues from selling of ERUs.

In many countries (Austria, Germany, Switzerland, Italy etc.) green tariffs have been already adopted. This fact is a key driver for the development of the market of energy production from biogas. On the moment of investment decisions making the green tariffs were not adopted in Ukraine. That's why green tariffs were not considered in additionality analysis.

In case of UDC project all electricity and heat produced in co generators from biogas will go on farms own needs.

Sub-step 4b: Discuss any similar Options that are occurring:

In USSR time a few small biogas plants have been working in Ukraine. In particular, biogas plants with volume of reactor 15 m^3 at battery farm "Kyivs'ka" as well as biogas plant at sovkhoz "Rossiya" (swine farm) with volume of reactor 170 m^3 per day were built. But after USSR disintegration these biogas plants stopped their work. So far, only one biogas plant is functioning in Ukraine. This biogas plant was built at swine farm "Agro-Oven" (Dnipropetrovs'k region, v. Elenivka) and includes 2 reactors with volume 1000 m^3 each. Biogas plants as a rule are very expensive. The possibility to construct biogas plant in Elenovka emerged only thanks to grant from government of Netherlands. The source of funding for UDC biogas project is bank credit. Hence Elenovka and UDC biogas projects have different sources of financing. Construction of biogas plants is not funding from Ukrainian government and there is no state program concerning development of biogas branch in Ukraine.

Biogas technologies for utilization of cattle, swine and poultry manure differ from each other. There is no relevant experience in Ukraine in exploiting of biogas plant with utilization of cattle manure. Therefore, the proposed project is the first of its kind.

Based on the above-mentioned it is possible to draw the conclusion that the project is additional.

B.3. Description of how the definition of the project boundary is applied to the project:

Livestock treatment at the Ukrainian Dairy Company Ltd. connected with emissions of following GHG:

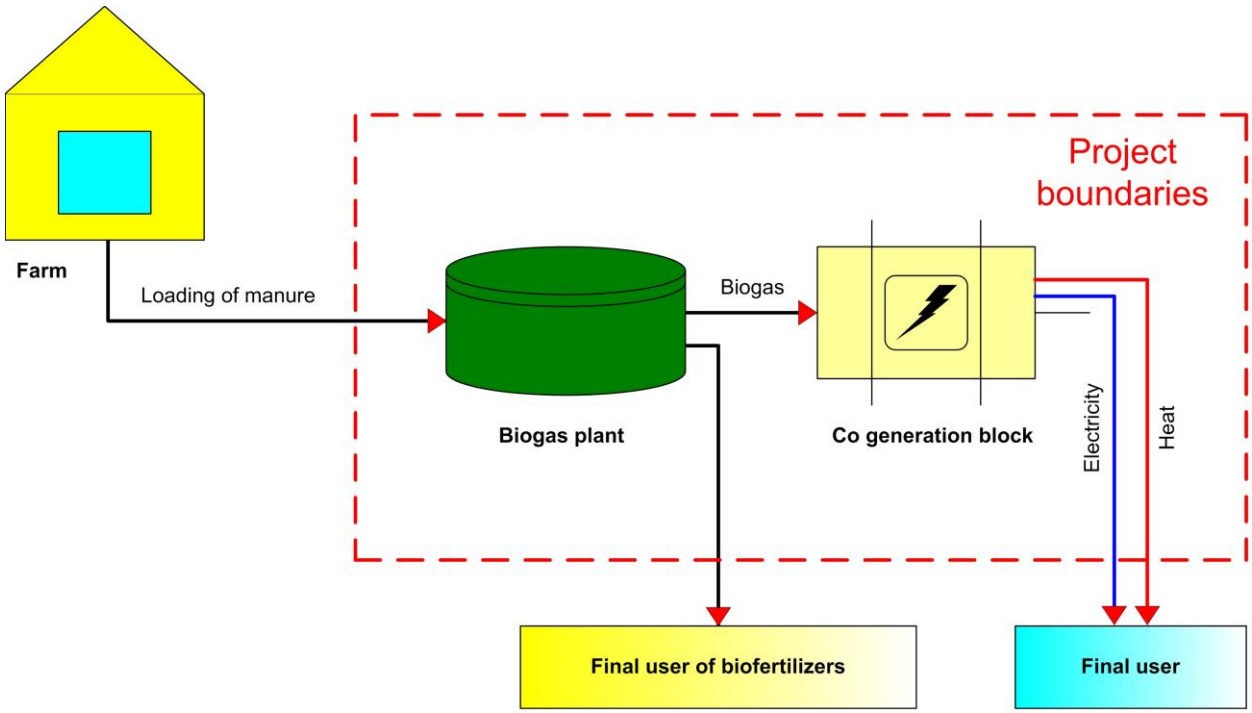
- CH_4 and N_2O from manure removal systems from cattle premises;
- CH_4 and N_2O from systems of storage manure in anaerobic lagoons;
- CH_4 and N_2O from systems of manure usage on fields as fertilizers;
- CH_4 from cattle enteric fermentation;
- CO_2 in consequence of consumption of electrical energy from the grid, which is received in the process of fossil fuel combustion at the thermoelectric power station.

In the Table given bellow there is a survey of GHG emissions sources during cattle treatment at the farms. For including the source in the frame of the project the following scheme was used:

- all emission sources on which the project has no influence were excluded;
- all emission sources on which the project has influence were included.

Source	Greenhouse gas	Influence	Included/ excluded	Substantiation/ explanation
Manure accumulated in cattle premises	CH_4	Direct	Excluded	The project has no influence on methane emissions from the given source
Manure accumulated in cattle premises	N_2O	Direct	Excluded	The project has no influence on nitrous oxide emissions from the given source
Manure stored in anaerobic lagoons	CH_4	Direct	Included	According to the project manure will go not to the lagoons but into biogas plants, and accumulated methane will be combusted in a cogeneration unit or flare candle
Manure stored in anaerobic lagoons	N_2O	Direct	Excluded	Nitrous oxide emissions are not considerable. Source is not included because of simplification (conservative estimate)
Manure used at the fields as a fertilizer	CH_4	Direct	Excluded	IPCC methodology for CH_4 emissions estimation at the stage of manure applying into soils is absent. The source is not included from the point of simplification (conservative estimate)
Manure used at the fields as a fertilizer	N_2O	Direct	Excluded	The source is not included from the point of simplification (conservative estimate)
Cattle enteric fermentation	CH_4	Direct	Excluded	The project has no influence on methane emissions from the given source
Combustion of fossil fuel at the thermoelectric power station	CO_2	Indirect	Included	Reduction of emissions will be achieved by substitution of energy generated from not renewable sources for electrical and thermal energy generated from the alternative sources

According to AMS-III.D and AMS-I.C methodologies, the project boundaries include equipment for methane collection and utilization – biogas plant and cogeneration unit (Picture 15).



Picture 15. Project boundaries.

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of emissions baseline setting – 21 November 2008.
Name of the organization: Environmental (Green) Investments Fund Ltd. (EGIF)
Address: 10b, Sofii Perovskoy str., Kyiv, Ukraine 03057
Contact person: Yuriy Valeriyovych Pyrozhenko
Job title: Expert on inventory and designing (Agricultural sector)
Phone/fax: (+38 044) 456-19-87
E-mail: yuriy.pyrozhenko@gmail.com

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the building and assembly works at Farm 1 (according to permission #12 for execution of construction work on reconstruction with expansion of existent dairy farm in Velykyi Krupil' village): 15.07.2008.
Date of the biogas plant launch at Farm 1: 01.11.2009.

C.2. Expected operational lifetime of the project:

15 years.

C.3. Length of the crediting period:

The length of the crediting period is 3 years and 2 months (from 01/11/2009 to 31/12/2012).
In case of adoption of the correspondent UNFCCC agreements as to a new commitment period, duration of the crediting period will be equal to the project lifecycle that is 15 years (2009-2023).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

Monitoring plan is a system of requirements to the method of carrying out monitoring and is an integrated part of project documentation.

The monitoring plan for the given project was elaborated according to AMS-III.D and AMS-I methods and methodological tool "Tool to determine project emissions from flaring gases containing methane".

Monitoring was carried out in compliance with Variant 1 that foresees application of formulas for calculation GHG anthropogenic emissions according to the baseline scenario and JI project, and determination of emissions reduction as a difference between them.

GHG emission reductions, achieved in any year y are determined $ex-post$ on the basis of the monitoring data as the lowest value calculated according to the formula:

$$ER_{y,ex-post} = \min\left[\left(BE_{y,ex-post} - PE_{y,ex-post}\right), \left(MD_y - PE_{power,y,ex-post}\right)\right], \qquad (2)$$

where:

$ER_{y,ex-post}$ - emission reductions achieved by the project activity based on monitored values for year y, t CO_2-eq./year;

$BE_{y,ex-post}$ - baseline emissions calculated using formula 1 (equations numbering corresponds to order numbers from AMS-III.D methodology, version 15) using ex post monitored values , t CO_2-eq./year;

$PE_{y,ex-post}$ – project emissions calculated using formula 2 using ex post monitored values , t CO_2-eq./year;

MD_y - methane captured and destroyed or used gainfully by the project activity in year y, t CO_2-eq./year;

$PE_{power,y,ex-post}$ – emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y, t CO_2-eq./year.

Methane captured and destroyed or used gainfully value MD_y calculated according to AMS-III.D with the formula:

$$MD_y = BG_{burnt,y} \cdot w_{CH4,y} \cdot D_{CH4} \cdot FE \cdot GWP_{CH4}\ , \qquad (3)$$

where:

$BG_{burnt,y}$ – biogas flared or combusted in the year y (m^3) ;

$w_{CH4,y}$ - methane content in biogas in the year y (mass fraction);

D_{CH4} - methane density (0,00067 t/m^3);

FE - flare efficiency in the year y (relative units);

GWP_{CH4} - global warming potential for methane (21).

Total amount of biogas that is flared and/or combusted and used for energy generation must be controlled by ex-post with the help of flow meters (gas-meters). Methane fraction in biogas is evaluated with the help of gas analyzers using periodical measurements at a 95% confidence level. Persistent biogas temperature and pressure monitoring is necessary for determination of flared methane density.

Monitoring plan scheme and scheme of informational flows for monitoring plan realization are given in Annex3.

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P1	Dairy cows population, N	Documents of the farm	heads	C	Daily	100%	Electronic copy	Data as to dairy cows population are calculated on the basis of the livestock turnover for the period
P2	Amount of manure that came into a manure management system, Q_m	Documents of the farm	kg/day	M	Daily	100%	Electronic copy	Equals to total amount of manure input in biodigester if MS_b =1
P3	A manure fraction processed in a biogas plant, MS_b	Documents of the farm	Relative units	E	Daily	100%		
P4	A fraction of dry substance in manure, f_d	Manure physical-chemical analysis	Relative units	M	Annually	100%	Electronic copy	Regular manure testing is carried out during a month to reduce inaccuracy of measurements
P5	Fraction of ash in manure, ASH	Manure physical-chemical analysis	Relative units	M	Annually	100%	Electronic copy	Regular manure testing is carried out during a month to reduce inaccuracy of measurements

P6	Flow of biogas coming into a cogeneration unit, V_1	Gas-meter indicators	m^3/hour	M	Every hour	100%	Electronic copy	Indicators of a gas-meter installed at the entrance of a gas pipeline into a cogeneration unit
P7	Flow of biogas coming into a flare candle, $V_2 = FV_{RG,h}$	Gas-meter indicators	m^3/hour	M	Every hour	100%	Electronic copy	Indicators of a gas-meter installed at the entrance of a gas pipeline into a flare candle
P8	Methane fraction in biogas w_1	Result of a biogas composition analyses taken for test at the entrance into a cogeneration unit	Relative units	M	Every two weeks	100%	Electronic copy	Withdrawal is carried out by a chemist-laboratory assistant of a biogas plant, analyses is performed in the laboratory of the Gas Institute of Ukrainian NAS
P9	Methane fraction in biogas $w_2 = fv_{CH4,RG,h}$	Result of a biogas composition analyses taken for test at the entrance into a flare candle	Relative units	M	On the day of a flare candle operation or one time every two weeks if en emergency situation at a cogeneration unit continues	100%	Electronic copy	Withdrawal is carried out by a chemist-laboratory assistant of a biogas plant, analyses is performed in the laboratory of the Gas Institute of Ukrainian NAS
P10	Methane fraction in biogas w_3	Result of a biogas composition analyses taken for test at the fermenter	Relative units	M	One time every two weeks	100%	Electronic copy	For quality control
P11	Biogas temperature, T	Sensor indicators	C^o	M	Every hour	100%	Electronic copy	Temperature and pressure control is

								implemented for methane density monitoring
P12	Biogas pressure, P	Sensor indicators	Kilopascal	M	Every hour	100%	Electronic copy	Temperature and pressure control is implemented for methane density monitoring
P13	Methane density, $\rho_{CH4,n}$	Defined by operator in accordance with temperature and pressure values	t/m^3	C	Daily	100%	Electronic copy	Determined according to temperature and pressure data
P14	Duration of flare unit operation, H_1	Recorded by operator	hour	E	Daily	100%	Electronic copy	
P15	Duration of cogeneration unit operation on biogas, H_2	Recorded by operator	hour	E	Daily	100%	Electronic copy	
P16	Duration of a cogeneration unit and tractor operation on fossil fuel, H_3	Recorded by operator	hour	E	Daily	100%	Electronic copy	
P17	Quantity of the fossil fuel combusted in co generator and tractor, $E_{d,h}$	Documents of the farm	l	M	Every month	100%	Electronic copy	In case a cogeneration unit uses fossil fuel for its operation
P18	Specific fossil fuel consumption, FC_s	Documents of the farm	l/kWh	C	In case a cogeneration unit uses diesel for its operation	100%	Electronic copy	

P19	Methane emissions due to storage of the final sludge PE_{fm}	Documents of the farm, physical-chemical analysis of the final sludge	tCO_2-eq.	C	Every year	100%	Electronic copy	Parameters that will be monitored include: amount of organic matter in manure, C:N and COD/BOD ratios

The project foresees ports for analyzing biogas composition at three fermenters at the place of a subsidiary valve installation and at the place of external pipeline conjunction with a flare candle and generator. System of gas control SGK-1 5BC.550.004, produced by JISK SPF SENSOR, Kharkiv, Ukraine will define methane fraction in biogas at inlets of co generators. Stationary gas-meters are installed (rotor gas-meter RGK-Ex) at the places of external pipeline conjunction with a flare candle and generator. Pressure sensors (IS-20-S, S1, ECO-1 WIKA) are installed, calibration of units has been carried out, operation is permitted with 1% allowance. Temperature sensors (TR10-C WIKA) are installed, calibration of units has been carried out, operation is permitted with the range of indicators -50 ... +250 C^0. Meter station of a generated heat (Supercom-01-SKS-3, НВП "Techprilad") is located at the heat pipeline site between a generator and heating center in technical premises 7.1., checked every 2 years. Every co generator is equipped with Siemens XPS electrical meter.

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

According to AMS-III.D methodology within the limits of project activities following GHG emissions are considered:

$$PE_y = PE_{PL} + PE_{flare} + PE_{power}\ , \qquad (4)$$

where:

PE_y - project emissions, t CO_2-eq./year;

PE_{PL} - methane emissions due to physical leakage of biogas in the manure management systems which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use, t CO_2-eq./year;

PE_{flare} - methane emissions from flaring or combustion of the biogas stream, t CO_2-eq./year;

PE_{power} - CO_2 emissions from the use of fossil fuel or electricity for the operation of the installed facilities, t CO_2-eq./year.

In accordance with methodology AMS-I.C project emissions are not calculated.
Containment of a gas collector and gas network according to the project was tested 7.11.2008 and is saved from (operating set of documents PE. MF "Heating technology"). However, project emissions due to physical biogas losses from the systems of its generation, collection and transportation to the combustion places were calculated according to the conservative principles as 10% (coefficient by default) from maximum methane generation potential of manure in fermenter (formula 5).

$$PE_{PL} = 0{,}10 \cdot GWP_{CH4} \cdot D_{CH4} \cdot B_o \cdot N \cdot VS \cdot 365 \cdot MS_b\ , \qquad (5)$$

where:

GWP_{CH4} - global warming potential of CH_4 (21);

D_{CH4} - CH_4 density (0,00067 t/m^3);

B_o - maximum methane producing potential from cattle manure, m^3/kg VS;

N - cattle population, heads;

VS - amount of volatile solids excreted with cattle manure, kg/head/day;

MS_b - fraction of manure handled in biodigester (according to project 100% of cattle manure will coming in biodigester).

Methane emissions in the process of biogas combustion PE_{flare} were calculated *ex-ante* based on equations from methodological "Tool to determine project emissions from flaring gases containing methane". In particular, value of mass flow rate of methane in residual gas in dry basis at normal conditions was calculated using the following formula:

$$TM_{RG,\mathrm{h}} = FV_{RG,\mathrm{h}} \cdot fv_{CH4,RG,h} \cdot \rho_{CH4,n}, \qquad (6)$$

where:

$TM_{RG,h}$ - mass flow rate of methane in the residual gas, kg/h;

$FV_{RG,h}$ - volumetric flow rate of the residual gas in dry basis at normal conditions, m^3/h;

$fv_{CH4,RG,h}$ - volumetric fraction of methane in the residual gas in dry basis at normal conditions;

$\rho_{CH4,n}$ - density of methane at normal conditions, kg/m^3.

Biogas flare at a candle takes place only in the emergency situation. The duration of its operation in emergency state, according to technical documentation elaborated by UKRNDIAGROPROEKT is 24 hours per year. Additionally, it is presumed that during 60 days (start up stage) biogas will be combusted at flare candle (for Farm 1 launching is in 2009, for Farm 2 – in 2010). In compliance with technical characteristics of a flare candle, received by the ZORG-UKRAINE company from the flare producer (Gas Institute of the Ukrainian NAS) nominal consumption of biogas for Farm 1 constitutes 500 m^3/h. This value was used in calculations for Farm 1 as a volumetric flow rate of the residual gas (conservative assumption). For Farm 2 it was assumed that nominal consumption of biogas is in direct proportion to livestock population. Resulting value of volumetric flow rate of the residual gas for Farm 2 is 750 m^3/h.

Volumetric fraction of methane in the residual gas for Farms 1 from results of biogas analysis of 02.06.2009 made by Gas Institute was taken and totals 65,97%. The same value was assumed also for Farm 2.

Project emissions from flaring were calculated based on methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency as follows:

$$PE_{flare,\mathrm{y}} = \sum_{h} TM_{RG,h} \cdot \left(1 - \eta_{flare}\right) \cdot \frac{GWP_{CH4}}{1000}, \qquad (7)$$

where:

η_{flare} - flare efficiency, fraction (flare efficiency for open flare is 50% by default).

Actual values of PE_{flare} will be calculated *ex-post* using methodological "Tool to determine project emissions from flaring gases containing methane" on the basis of monitoring results of the volumetric flow rate of the residual gas in dry basis at normal conditions, volumetric fraction of methane in the residual gas on dry basis, temperature and pressure of gas and number of hours operated in emergency state.

For proposed project there are three sources of project emissions from the use of fossil fuel or electricity for the operation of the installed facilities (PE_{power}):

- consumption of electricity from the grid;
- using of diesel fuel for co generators operation;
- consumption of diesel fuel by tractors that will mix fermented mass after biogas plant to ensure aerobic conditions.

For pumps and mixers operation as well as for warming biogas plants electrical energy and heat received from alternative sources but not as a result of fossil fuel combustion will be used.
But according to data from company-supplier of biogas equipment for the project in period of putting into operation of biogas plants at Farms 1 and 2 certain amount of electricity from grid should be utilized (292,8 and 585,6 MWh correspondingly). Project emissions for electricity consumed from the grid were calculated by multiplying of quantity of electricity by emission factor that is based on research data of Global Carbon B.V.[18] and amounts to 0,807 t CO_2 /MWh.
CO_2 emissions from diesel fuel used for co generators and tractors work were calculated in accordance with the following equation[19]:

$$PE_{power,dy} = \sum_h E_{d,h} \cdot k_c \cdot k_o \cdot Q_n \cdot \frac{44}{12}, \qquad (8)$$

where:
$E_{d,h}$ - amount of diesel fuel consumed, t/h;
k_c - carbon content in diesel fuel, tC/TJ;
k_o - carbon oxidized factor, fraction;
Q_n - net calorific value of diesel fuel, TJ/1000 t.
According to the project documentation and cogeneration unit technical characteristics, fossil fuel – diesel fuel of L type, DSTU 3868-99, will be consumed only in emergency situation. The duration of its operation in emergency state, according to technical documentation elaborated by UKRNDIAGROPROEKT is 24 hours per year. It is expected that tractors at Farms will mix fermented mass 8 hours per day or 968 hours in 2009 and 2920 h/year during the period 2010-2012.
Value of amount of diesel consumed to power co generators at Farm 1 was taken from Environmental Impact Assessment[20] and equals to 0,017 t/h. For Farm 2 this value is based on assumption and constitutes 0,028 t/h. Quantity of diesel fuel utilized by tractors at Farms was estimated based on average amount of diesel consumed by John Deere tractors as well as diesel density that equal to 36,3 liters/h and 850 kg/m^3 correspondingly. Resulted amount of diesel consumed by tractors for both Farms makes up 0,031 t/h.
Data source for carbon content in diesel fuel and carbon oxidized factor that make up 20,2 tC/TJ and 0,99 accordingly – Revised IPCC Guidelines 1996[21].
Country-specific net calorific value of diesel (42,4 TJ/1000 t) from Ukraine's National Inventory Report on GHG emissions and absorption for 1990-2006 (Annex 2, table A2.3) was taken.
Actual emissions from fossil fuel consumed will be calculated $ex-post$ according to the monitoring results of operation in emergency state and amount of diesel fuel used. To ensure the monitoring of diesel consumption the next information is fixed in the Monitoring Journal: simply filling in of each tank of diesel generator fuel, the degree of its filling (the per cent on the front panel of the generator) and hours of work. Fuel consumption is to be calculated according to the technical characteristics of

[18] Study "Standardized emission factors for the Ukrainian electricity grid" (Version 5, 02 February 2007) developed by Global Carbon B.V.

[19] Ministry for the environmental protection of Ukraine (2008). Ukraine's National Inventory Report on GHG emissions and absorption for 1990-2006 (Chapter A2.3.3, equation A2.1).

[20] Reconstruction with the existing milk farm expansion in the village of Velykyi Krupil', Zgurivsk rayon, Kyiv oblast. Working design, Volume 1 EIA, «UKRNDIAGROPROEKT», Kyiv, 2008.

[21] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual.

the generator Magnum G400 VSA - 120 liters per 5 hours. Built-in electronic sensor of fuel tank filling degree is not subject to calibration.

In defined conditions the final sludge can still be a source of methane emissions to atmosphere. That's why the proper soil application (not resulting in methane emissions) of the final sludge will be ensured. In particular, this sludge will be spread on the fields uniformly by small portions avoiding over-application and under-application. In conformity with physical-chemical analysis for Farm 1 the organic matter content in fresh manure at the inlet of biogas plant amounts to 85% (ASH content amounts to remaining 15% of manure dry matter). During digestion process the one part of organic substance is a basis for biogas generation and the other part is utilized for microorganism's biomass growth.

The organic matter is in stabilized form and methane emissions are not occurring in completely digested manure. The technical digestion limit value can be used to determine whether manure is completely fermented or not. Technical digestion limit is a maximum outlet of gas from organic matter that is loaded to biodigesters[22]. In Work project for Farm 1, the value of technical digestion limit that amounts to 40-45% of organic substance for cattle manure is proposed. As a rule, fermented sludge is characterized as stabilized when 90% from technical digestion limit is achieved. Therefore, methane emissions will not occur if remaining amount of organic matter in digested sludge is in the range of 60-64% from total quantity of organic substance in fresh manure at the inlet of biogas plant. If amount of organic matter is more than 64% - some emissions can still take place. To avoid anaerobic decay of remaining organic matter at the outlet of biogas plant mechanical mixing with a tractors John Deere 8430, HOULE pump and injector barborator 8 hours per day (2 920 hours per year) will be implemented at both Farms.

During the digestion process gradual reduction of carbon quantity due to its converting to CH_4 and CO_2 consisting of biogas is observed. Forms of carbon are also to be changed by way of converting to carbonate and bicarbonate ions of liquid fraction that are not belong to volatile compounds as well as to cell substance of biomass. Substantial part of organic nitrogen is converted to mineral forms (NH_2 amid is converted to NH_4 and connected with dissolved CO_2). It leads to increase of alkalinity of the system and as a consequence – decreasing of C:N ratio. Stabilized sludge is characterized by C:N ratio that equals to or less than 10 (optimal C:N ratio for methanogenesis is in the range of 16-19).

Besides, process of biomass digestion is accompanied by gradual accumulation of NH_3, which belongs to inhibitors of methanogenesis.[22]

Each type of sludge is characterized by initial COD/BOD ratio. According to investigations data[23] portions of COD and BOD that are lost during the digestion process make up 40-60% and 60-90% accordingly from COD, BOD values in initial sludge. High COD/BOD ratio means that the organic matter is in stabilized form (methane emissions are not occuring).

The amount of organic matter in digested manure as well as C:N and COD/BOD ratios will be the subject of regular monitoring.

According to AMS-III.D methods within the project activity if a cogeneration unit uses fossil fuel during a definite period of time, amount of electrical and heat energy received in this case is deducted from total amount of produced energy according to the monitoring results on the basis of records of fossil fuel specific consumption for energy generation.

[22] L.I. Gyunter, L.L. Gol'dfarb. Biodigesters, M: Stroyizdat, 1991. – 128 p.

[23] Parkin G.F. Fundementals of anaerobic digestion of waste water sludge. Environ. engineering. -1986, #5, p. 867-920.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B1	Dairy cows population, N	Documents of the farm	heads	C	Daily	100%	Electronic copy	Data as to dairy cows population are calculated on the basis of the head turnover for a definite period
B2	Methane conversion factor for the anaerobic lagoons, MCF	Guiding principles of national inventories of greenhouse gases IPCC 2006 (Table 10.17)	Relative units	E	Annually	100%	Electronic copy	Methane correction factor is evaluated with the help of the IPCC 2006 Guidelines on the basis of the latest Central geophysical observatory (CGO) data as to the average annual temperature
B3	Amount of manure that came into a manure management system, Q_m	Documents of the farm	kg/day	M	Daily	100%	Electronic copy	Equals total amount of manure that came into anaerobic lagoons MS_L=1

B4	Fraction of dry substance in manure, f_d	Physical-chemical manure analyses	Relative units	M	Annually	100%	Electronic copy	According to AMS-IIID methodology VS values depend on genetic source of the production operations livestock as well as formulated feed rations. All dairy cows at Farm 1 belong to one genetic type (Holstein breeds). The same genetic type of cows is envisaged at Farm 2. Feeding of the same type is currently used at Farm 1 and planned at Farm 2 during the year (cows are not pastured). Considering above mentioned, monitoring of f_d value is performed not monthly but once a year (the same monitoring frequency is for ASH fraction) Regular sample withdrawal is carried out during one month to reduce inaccuracy of measurements
B5	Ash fraction in manure, ASH	Physical-chemical manure analyses	Relative units	M	Annually	100%	Electronic copy	Regular sample withdrawal is carried out during one month to reduce inaccuracy of measurements
B6	Amount of electrical energy generated by a cogeneration unit	Indications of electrical energy meters installed at a cogeneration unit	kWh	M	Monthly	100%	Electronic copy	
B7	Amount of electrical energy substituted by heating energy generated by a cogeneration unit	Indications of heating energy meter installed at a cogeneration unit	MWh	C	Monthly	100%	Electronic copy	Is calculated by the division of produced thermal energy amount by electrical heaters efficiency that equal to 0,68 relative units

B8	Amount of electrical energy substituted in the result of the project activity, EC	Calculated by the operator as sum (B6+B7)	MWh	C	Monthly	100%	Electronic copy	20% of electrical energy and heat generated in a cogeneration unit according to the project are used for the biogas plant operation and the rest 80% is used for the farm needs
B9	CEF CO_2 emission factor for the Ukrainian energy system (displacement or consumption of energy from grid)	Determined according to the data from most recent approved baseline study	tCO_2/MWh	E	Annually	100%	Electronic copy	Exclusively emission factor approved by an accredited independent entity under the Joint Implementation Supervisory Committee (JISC) is used in calculations

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Following methodology AMS-III.D "Methane recovery in agricultural and agro industrial activities" methane emissions according to the first component were calculated using Tier 2 approach set in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (volume 4, chapter 10), however, taking into account uncertainties.

In view of the aforesaid methane emissions in compliance with the first component (AMS-III.D) were calculated using formula:

$$BE_{C1} = GWP_{CH4} \cdot D_{CH4} \cdot MCF \cdot B_o \cdot N \cdot VS \cdot 365 \cdot MS_L \cdot UF_b, \qquad (9)$$

where:

BE_{C1} - GHG emissions according to the first component, t CO_2-eq./year;

GWP_{CH4} - methane global warming potential (21);

D_{CH4} - methane density (0,00067 t/m^3);

MCF - methane conversion factor for anaerobic lagoons, fraction;

B_o - maximum methane producing capacity for dairy cattle manure, m^3/kg VS;

N - amount of dairy cattle, heads;

VS - amount of volatile solid excreted with dairy cattle manure, kg/day;

MS_L - fraction of dairy cattle manure handled using anaerobic lagoons;

UF_b - correction factor for considering uncertainties.

Cattle livestock is calculated in special electronic registers based on livestock turnover for the period which equates to a balance: sum of cattle head at the beginning of the period and all income should amount to sum of all outlay and cattle head at the end of the year.

Value of volatile solid excreted with dairy cattle manure VS was calculated on the basis of Ukraine's national methodology (formula 10)[24]:

$$VS = DM \cdot (1 - ASH), \qquad (10)$$

where:

DM - amount of manure produced, kg of dry matter/head/day;

ASH - ash fraction (non-organic component) in manure.

Value of the amount of manure produced in dry matter/head/day (DM) was calculated on the basis of the following formula:

$$DM = \frac{Q_m}{N_T} \cdot f_d, \qquad (11)$$

[24] Ministry for the Environmental Protection of Ukraine (2008). Ukraine's National Inventory Report on GHG emissions and absorption for 1990-2006.

where:

N_T - amount of dairy cattle at the farm as of April 2008, heads;

Q_m - amount of manure getting to manure management system, kg/day;

f_d - fraction of dry matter in manure.

Values of dry matter fraction in manure (f_d) and ash fraction (ASH) were taken on the basis of manure physical-chemical analysis data carried out at Farm 1 in April 2008 in scientific laboratory of ecological as well as sanitation and epidemiological monitoring of Agro-industrial Complex enterprises, Chair of animal hygiene and livestock ecology named after A.K. Skorohodko, National University of Life and Environmental Sciences of Ukraine (the lab is certified).
Sampling for analysis was taken from two different sites: test 1 – swap pump, test 2 – mixing pump.
The analysis results are given in table 9.

Table 9. – Cattle heads' manure physical-chemical analysis results, Farm 1.

Index	**Dry matter fraction in manure**	**Ash fraction in manure**
Test 1	0,052	0,148
Test 2	0,066	0,149
Average value taken for calculations	0,059	0,1485

In the calculations of the baseline the assumption was made that values DM and ASH for the Farms 1 and 2 are equal.

There were 2000 cattle heads at the farm (N_T) at the time of manure sampling (of April 2008). Amount of manure accumulated in livestock premises is taken as equal to 140000 kg/day. After manure is brought into circulating cross ditches by a bulldozer, it is mixed with 60000 kg of sewers from a milking parlor, producing in such a way 200000 kg of manure per day, that get to anaerobic lagoons (Q_m).

The data taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (table 10 A-4, data for Eastern Europe) were used as a value of maximum methane producing capacity for cattle manure. In accordance with the table 10 A-4, B_0 value for dairy cows makes up 0,24 m^3/kg VS.

Methane conversion factor is based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (table 10.17, data for Eastern Europe) as well. Climate of the region, where the project objects are located, was taken into account while determining the methane conversion factor. According to Central geophysical observatory (CGO) data average annual temperatures in Kyiv and Chernigiv oblasts did not exceed 10ºC for the period of 1990-2006 (table A2.1).
In accordance with the Construction norms and regulations (СНиП) data 2.01.01-82 «Construction Climatology and Geophysics»[25] average annual temperatures average values for the period of 1881-1960 in Kyiv and Chernigiv oblasts made up 7,2 and 6,5 ºC.
According to 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 10ºC temperatures and lower (cold climate according to the IPCC classification) correspond to methane conversion factor of 0,66.
MS_L value is taken for 1, as 100% of cattle manure is stored in anaerobic lagoons.
Factor for taking into account uncertainties is taken for 0,94.[26]

[25] Construction norms and regulations 2.01.01-82 «Construction Climatology and Geophysics». Decree of the Gosstroy of the USSR of 21.7.82 #188. Published: Official edition, Ministry of Construction - M: GP CPP (ГП ЦПП), 1996.

[26] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

GHG emissions according to the second component were calculated taking into account requirements of AMS-I.C methodology "Thermal energy for the user with or without electricity".
Within the framework of the proposed project electrical energy, consumed at the farms, (including electrical energy, used for water heating in boilers) will be displaced by a correspondent amount of electrical and thermal energy, generated from the alternative sources. In accordance with AMS-I.C methodology, baseline (BE_{C2}) emissions where calculated by multiplying of amount of energy displaced on CO_2 emission factor for electricity grid (formula 12).

$$BE_{C2} = EC \cdot CEF, \qquad (12)$$

where:
EC - annual amount of electrical energy displaced by the project activity, MWh;
CEF - CO_2 emission factor for electricity grid of Ukraine, t CO_2/MWh.

In calculations it was assumed that 20% of electrical and heat energy produced in co generators at Farms 1 and 2 will be spend on biogas plants functioning (conservative assumption).
In accordance with the baseline scenario electrical heaters for heating of water coolant are used. Amount of electrical energy displaced by heat energy within the project was calculated as quantity of heat produced in co generators and electric heaters efficiency ratio (0,68).Values of electrical energy amount, received from the grid that will be displaced by the energy, generated by the co generator, using biogas as a raw material, within the crediting period are indicated in table 10:

Table 10. - Annual amount of electrical energy that will be displaced by the project activity, MWh.

Year	**Farm 1**	**Farm 2**	**Total**
2009	2 932	-	2 932
2010	16 237	23 785	40 023
2011	16 237	26 002	42 239
2012	16 237	26 002	42 239

Research data of Global Carbon B.V.[27] on Standardized factors of CO_2 emission by the Ukrainian electricity grid were used as emission factors. CO_2 emission factor for projects aimed at reducing energy consumption from grid to which the project belongs according to research classification amounts to 0,896 t CO_2 /MWh.

[27] Study "Standardized emission factors for the Ukrainian electricity grid" (Version 5, 02 February 2007) developed by Global Carbon B.V.

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

Is not applied.

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Is not applied								

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Is not applied.

D.1.3. Treatment of leakage in the monitoring plan:

According to methodologies AMS-III.D and AMS-I.C leakages for current project are not calculated.

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Is not applied								

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

Is not applied.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Values of ERUs amount were calculated as a difference between GHG emissions according to the baseline and GHG emissions according to the project (formula 13).

$$ER = BE - PE, \qquad (13)$$

where:

ER - amount of GHG emissions reductions that will be created as a consequence of the project implementation, t CO_2-eq./year;

BE - GHG emissions according to two components ($BE_{C1} + BE_{C2}$), t CO_2-eq./year;

PE - GHG emissions according to project scenario, t CO_2-eq./year.

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

Information as to GHG emissions monitoring according to the baseline and project scenarios are archived and kept in computer and on hard copies and are at disposal of a person authorized by the Ukrainian Dairy Company Ltd. director to be responsible for the project monitoring. This person also keeps monitoring annual reports and reports on verification of emissions reduction.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
B3	0,5%	Cross controls with daily indications of fermenters loading
B4, B5	0,7%	Control physical-chemical analyses of manure composition in the laboratory of the Technical Thermophysical Institute of the NAS of Ukraine. Comparison of physical-chemical analyses results with sectoral norms and explanation of differences
B6	1%	Different electrical meters are installed at the farm. They allow to lead at the farm constant measuring of consumption of electrical energy generated by the cogeneration unit. Electrical meters are calibrated by the authorized body at least every three years. Electrical meters data will be fixed by a biogas plant operator in a Monitoring journal

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

Monitoring of emissions according to the project and baseline scenarios for the given project – activity as to collection and archiving of all data necessary for measuring GHG anthropogenic emissions within the project framework during crediting period – is carried out by the project owner Ukrainian Dairy Company Ltd. The staffing table of those servicing the biogas plant includes a senior operator, an operator on duty and a chemist-laboratory assistant. They have the following responsibilities: collection and keeping of primary information for monitoring of GHG emissions reduction carried out according to the project.

- fixing meters indications with periodicity identified in a monitoring plan;

- inserting fixed data into the Monitoring journal of GHG emission reductions;
- withdrawing physical-chemical analyses of samples for analyses;
- transporting of samples to laboratories;
- recording analyses results into the Monitoring journal of GHG emission reductions.

The Monitoring journal of GHG emission reductions, hereafter Journal, is kept daily in electronic form (EXCEL tables) separately at Farm 1 and Farm 2. On the first date of every month the Journal for the previous month is printed out in two copies and is signed by two authorized persons. One copy is kept at the farm. The second copy is submitted to an authorized person from the Ukrainian Dairy Company Ltd. central office, which is responsible for GHG emissions reduction monitoring within the project. Monthly data from the farms are also sent in electronic form.

An authorized person from the Ukrainian Dairy Company Ltd. central office, who is responsible for GHG emissions reduction monitoring within the project, is assigned by the Ukrainian Dairy Company Ltd. director's order. The information from the both farms is kept and archived in the above mentioned person's computer and in a hard copy.

At the end of the year this person is responsible for annual verification organizing and takes part in annually monitoring report preparation (submission of information for calculation of GHG emissions reductions) from the part of project owner.

Calculations of GHG emissions reduction within the project and report on monitoring are carried out on the basis of annual data submitted from Ukrainian Dairy Company Ltd. central office by the specialists of Environmental (Green) Investments Fund.

Laboratory of ecological and sanitary-epidemiological monitoring of AIC enterprises, chair of cattle hygiene and cattle ecology named after A.K. Skorohodko of the National University of Life and Environmental Sciences of Ukraine (laboratory is certified)

Physical-chemical manure and final sludge analyses.

Laboratory of the Institute of technical thermophysics of the NAS of Ukraine

Physical-chemical manure and final sludge analyses. Quality assurance/control procedures.

Laboratory of the Gas Institute of the NAS of Ukraine

Identification of qualitative and quantitative biogas composition every two weeks with the help of a gas analyzer. Samples are withdrawn by laboratory assistants at Farm 1 and Farm 2 in special gas sampling tube with two taps and are submitted to the laboratory.

Central geophysical observatory

Annual approval of an average value of average temperatures for Kyiv and Chernigiv regions that are necessary for monitoring of methane conversion factor value for anaerobic lagoons (MCF).

The procedure for storage and use of fermented mass in the fields as fertilizer

1. The fermented mass from fermenters number 1, 2 and 3 is collected in an open tank by means of airlift in accordance with load-unload overflow schedule. Then, without any additional processing in the automatic mode, the fermented mass is pumped into the lagoon (Farm 1 is provided with 4 lagoons 12600 m^3 volume each, on a Farm 2 - five ones, 25000 m^3 volume each). The average level of lagoons filling with fermented mass is not more than 2m. The fermented mass is stored in lagoons no more than six months.

2. The fermented mass mechanic mixing in the lagoons is provided with the help of pumps in order to ensure aerobic conditions for mass storage. The pumps operating time is assumed to be 8 hours per day for 365 days (2920 hours/year). The average capacity of one pump an average of 1890 l/min.

The pump works intermittently for 24 hours.

3. Storage time for biomass obtained at the biogas plant output on both farms directly depends on the terms of this mass application in the soil as fertilizer. The use of fermented manure as fertilizer should be implemented in the optimum terms of agricultural technology.

4. Manure in liquid form should be applied under the agricultural crops twice a year (autumn and spring), this process is accompanied with the 100% lagoons emptying. Manure is to be applied only once every two or three years in the same area (in case of the annual application of fermented manure in one area the prescribed dose should be less by 30% then the optimal one).

5.The annual input of organic fertilizers norm calculation should be based on the requirements of the rules Technological Designing Departmental Regulations of Agro-Industrial Complex (ВНТП-АПК) 09.06 "Systems of manure removal, treatment, preparation and usage", Kiev 2006, Ukraine APC) regarding to fertilizing value of organic matter and removal of biogenic elements (nitrogen, phosphorus and potassium) by the planned harvest crops.

6. During the agricultural land areas calculations for manure application it is necessary to take into account the biogenic elements losses caused by manure digestion in the fermenters of a biogas plant and its fertilizing value (determined on the basis of physical-chemical analysis of fermented mass).

7. Digested manure is applied under crops by means of tank-type spreaders RZHT. Liquid manure is spread on the soil surface by equal portions, it is necessary to avoid fertilizer under and over application. Then the soil should be ploughed up again.

8.Amounty of fertilizers for high-yielding forage crops (maize silage, fodder beet, grasses, etc.) should be up to 400 kg/ha total nitrogen, for grain - 100-150 kg/ha. The area of agricultural land, which would be fertilized with fermented mass twice a year is 790 hectares in Chernigiv region and 525 hectares in the Kiev region under maize for silage and fodder beet, as well as for grain crops. The nitrogen content in fermented mass for Farm 1 is 0,76 tons of nitrogen per day, for Farm 2 -1,13 tons of nitrogen per day.

The sampling procedure

Sampling and sample analysis are carried out in accordance with established zootechnics procedures and on the basis of "Instructions on laboratory monitoring of waste disposal plants at cattle-breeding complexes"[28]. Samples of fermented mass are separated on non-permanent, average and audit assays. Non-permanent sample of fermented mass is picked out in one sitting in definite terms. It characterizes composition and quality of fermented mass both at the place of sample splitting and through the time. Average sample is obtained by the ways of mixing of a few non-permanent assays that are picked up in one or several places, at different levels and time. Lower-range value of average sample that is taken for analysis is called average laboratory sample. This sample is stored in a correspondent package (as a rule in glass jars) that prevents changes in humidity, composition and properties. Audit assay is a part of non-permanent or average sample (reserve sample). Reserve sample is used during retests of audit analyses, for comparison etc. Sampling of fermented mass is applied with the expectation of obtaining of the most accurate characteristics of investigated volume (universal set).

Sampling of fermented mass is carried out:

- with the help of triers;
- at different depth (1 and 2 m);
- in a few places that are characterized by effective mixing and hit of foreign matter is impossible (at the outlet of biogas plant, in open tank as well as uniformly through out the whole area of lagoons with fermented mass);

[28] "Instructions on laboratory monitoring of waste disposal plants at cattle-breeding complexes", M., "Kolos", Part I – 1982, Part II – 1983 and Part III – 1984.

- every year in July during the whole month (according to Central Geophysical Laboratory data July is the most warm month in Ukraine)[29];
- every 10 minutes 3 times per day (1 hour in the morning, afternoon and evening);
- in equal volumes (approximately 1 liter)[30];
- in equal quantity (5 samples are taken in each place).

Samples are put into the glass or polyethylene jars. Covers of jars are wrapped up with polyethylene film, compact paper and tied up by twine. Labels with specification of date and place of sampling, title of biogas plant, surname and position of person responsible for sampling are attached to each jar. Samples of fermented mass are registered in special journal. Sample is placed into the clean laboratory glassware, hermetically closed up with cork and stored at temperature not higher than 4-5°C. Working life of sample should not exceed 24 hours.[31]

Laboratory analysis of each sample is performed 3 times to reduce uncertainties.

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

Name of the organization: Environmental (Green) Investments Fund Ltd. (EGIF)
Address: 10b, Sofii Perovskoy str., Kyiv, Ukraine 03057
Contact person: Maryna Volodymyrivna Bereznytska
Job title: expert in inventory and designing (Wastes/Alternative energy sector)
Phone/fax: (+38 044) 456 19 87
E-mail: mbereznytska@gmail.com

[29] http://www.cgo.kiev.ua/index.php?fn=u_klimat&f=ukraine&p=1.

[30] E.M. Kigel. Exploitation of sewage disposal plants. K: "Budivel'nyk", 1978. – 143 p.

[31] Research and treatment of waste water sludge/Tereschyuk A.I. – Lvov: Vyscha Sh. Izd-vo pry Lvov. un-te, 1988. – 148 p.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Year	Farm 1, t CO_2-eq.	Farm 2, t CO_2-eq.
2009	4 778	-
2010	2 806	9 898
2011	2 806	4 069
2012	2 806	4 069
Total for 2009-2012	13 197	18 037

E.2. Estimated leakage:

According to methodologies AMS-III.D and AMS-I.C leakages for current project are not calculated.

E.3. The sum of E.1. and E.2.:

Year	Farm 1, t CO_2-eq.	Farm 2, t CO_2-eq.
2009	4 778	-
2010	2 806	9 898
2011	2 806	4 069
2012	2 806	4 069
Total for 2009-2012	13 197	18 037

E.4. Estimated baseline emissions:

Year	Farm 1, t CO_2-eq.		Farm 2, t CO_2-eq.	
	BE_{C1}	BE_{C2}	BE_{C1}	BE_{C2}
2009	5 094	2 627	-	-
2010	15 366	14 549	23 049	21 312
2011	15 366	14 549	23 049	23 298
2012	15 366	14 549	23 049	23 298
Total for 2009-2012	51 193	46 272	69 148	67 907

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

Year	Farm 1, t CO_2-eq.	Farm 2, t CO_2-eq.
2009	2 942	-
2010	27 109	34 463
2011	27 109	42 278
2012	27 109	42 278
Total for 2009-2012	84 268	119 018

E.6. Table providing values obtained when applying formulae above:

Year	Emissions according to the project scenario, t CO_2-eq.	Emissions according to the baseline scenario, t CO_2-eq.	Volume of emission reduction, t CO_2-eq.
2009	4 778	7 721	2 942
2010	12 705	74 276	61 571
2011	6 876	76 262	69 386
2012	6 876	76 262	69 386
Total for 2009-2012	31 234	234 520	203 286

Risks and uncertainties

Factors of risk that can lead to the waste or overview (in direction of decrease) of the expected ERU in crediting period:

- technological risks;
- operational risks.

Technological risks.

Adaptation of the German technology to the Ukrainian climatic conditions and peculiarities of the manure chemical composition that in its turn depends on the structure of forage rations. Equipment and technology supplier of the project has extensive experience in servicing of the equipment already in use in Ukraine. ZORG-UKRAINE has been servicing biogas digester in Agro-Oven, village of Elenivka, Magdalene distr., Dnipropetrovsk region since September 2007.

Operational risks

- reduction of cattle livestock at the farms;
- reduced power demand due to setback in production.

Table 11. Ways to mitigate possible operational risks.

Title	Measures to reduce risks
Degradation of forage stock	1. There exist own land recourses to grow forage; 2. Confirmed additional outside supply schedule 3. The system of 1-year additional forage supply contracts has been implemented; 4. There are reserve silo pits in the farm premises.
Reduction of cattle livestock at the farms	1. The business plan does not foresee any livestock reduction, on the contrary, development and construction of new stock farms; 2. Contracts have been concluded to sell milk with two largest milk processing companies Vim Bill Dan Ukraine and Galychyna.
Reduced power demand due to decrease in production	Electric and thermal power produced in the project is used to cover own needs.

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

Effect of the project on the environment in the areas of the project location and in the bordering territories at Farm 1 was evaluated in compliance with SBU (Derzhbud of Ukraine) A.2.2-1-2003 "Composition and content of evaluation materials on the effect on environment in designing and construction enterprises, houses and erections. Main provisions of designing", adopted by the Derzhbud of Ukraine order of 15.12.2003 #214 that came into force from 01.04.2004.

The customer of the «Composition and content of the materials on the evaluation of the environmental effects while designing and constructing plants, houses and buildings. Main provisions of Design» (EIA) documents is Ukrainian Dairy Company Ltd. The EIA general designer and executor is UKRNDIAGROPROEKT association of Ukrainian Ministry on agricultural industry that is located at 2, Solomianska square, Kyiv, Ukraine, 03035. General director M.F. Galibarenko, tel.: 248-70-52.

Executives in charge: the chief of the VRNTP-1 department – P.O. Rykovtsev, chief engineer of the project – G.G. Marchenko, tel.: 248-81-83.

At Farm 1 ecologically safe and energy saving technologies for keeping livestock and manure removal, transportation, fermentation and using are implemented. These technologies are implemented in European and American developed countries that use biogas plant for the amount of manure of the extended dairy farm and partially from the existed dairy farm.

For realization of the planned activity the following resources are necessary:

Land

For allocation of the planned activity additional land site with area 20,0 ha is used. This site is taken at the expense of the lands for agricultural purpose within Velykokrupilska village council. Thus, the necessary area of the land site is 43,1 ha, including 23,1 ha of designated area and 20,0 ha of additional designated area.

Raw materials

Needs in livestock for Farm 1 extention are 2000 forage cows of foreign selection which will be brought from Germany. Further the needs will be covered at the expense of growing cows in the sector for growing heifers and calves.

Water

Two water well-holes are the source of the service and industrial water pipeline. Two water towers 170 m^3 each will be installed to regulate water supply within a water pipeline system.

Expenses of drinking water for cows make 178,0 thousand m^3 a year, including. 95,6 thousand m^3/year at the operating farm and 82,4 thousand m^3/year for the dairy farm extension. Water expenses for cleaning and washing make 22,6 thousand m^3 a year, including 5,8 thousand m^3 at the operating farm and 16,8 thousand m^3 for the dairy farm extension. For the complex fire protection needs automatic hydraulic power station and two fire-protection tanks 100 m^3 each are planned. Calculated expenses of water for external fire fighting are 210 m^3 for three hours.

Energy

Energy needs are covered by the biogas plant thermoelectric generator. Additional energy supply source is PS 35/10 kV Voykovo. Electrical supply from the planned station is 10/0,4 kV, maximum capacity is 1100 kW. Energy supply source in case of emergency is the biogas plant thermogenerator that uses diesel fuel and assigned for ensuring work of milking cow parlors. The main project technological solutions foresee energy saving technology of the operating farm (milk herd management, milking cows, growing heifers and manure removal, transportation, fermentation and usage). High-productive livestock will be brought from Germany. Cow management at the planned farm is cold, without taking it out, untied, rest in boxes using bedding (sawdust). Heifers management is carried out in corresponding sheds, it is cold, untied, on a bedding (sawdust). In the process of livestock management the following contaminants will appear: methane, ammonia, fur dust, hydrogen sulphide, methylmercaptan.

Pure manure (without bedding) removed from cows and heifers' sheds is pumped from the receiving and pumping station tank to a biogas plant. Manure storages are the sources for ammonia creation. Thermogenerator at a biogas plant is a source for nitrogen dioxide, carbon oxide, formaldehyde creation in the process of liquid manure fermentation. Vehicle explosion engine is a source for nitrogen, carbon and carbohydrate oxides creation during transportation. In emergency situations a cogeneration unit that uses diesel fuel is a source for sulphuric acid dioxide, nitrogen dioxide, carbon oxide and soot creation. Biogas surplus is combusted at the gas flare, which in emergency situation is a source for nitrogen and carbon oxides and formaldehyde creation. An emergency situation at Farm 1 is possible at the manure receiving and pumping stations in case the pump that pumps manure into manure storages stops. In this case a sound signal (siren) switches on and manure transportation into the manure storages is carried out by wet organic fertilizers spreading equipment that has a tank and a pump for pumping liquids. Using of hermetic pipeline for manure transportation and water proofing in manure storages makes it impossible for manure to get into the ground and ground waters. In case of emergency situation at the biogas plant (gas supply termination) the thermogenerator uses diesel fuel and biogas surplus is combusted at the gas flare. Technological processes of livestock management and manure keeping belong to potential sources of effect on one of the main environmental components – air. Besides, processes of biogas combustion in a biogas plant thermogenerator and processes of fuel combustion in vehicles explosion engines also belong to potential sources of effect on environment. In case of emergency situation at a biogas plant sources of effect on air environment are determined due to diesel fuel combustion in a biogas plant thermogenerator and biogas combustion in a gas flare.

Industrial sewage, service and household waters, surface waters, industrial, service and household waters belong to potential sources of effect on soil and water. The potential objects of influence include: air, water and soil.

The main object of influence is air. The area of effect on air is determined due to contaminants spreading. In the dwelling area that is included into the Farm 1 sanitary and protected zone the effect does not exceed the values of contaminants (C) limit admissible concentrations. The Farm 1 designing is made with due consideration of the standards of town building, sanitary, fire protecting and technological requirements and in compliance with the State building standards.

According to the veterinary requirements the Farm 1 territory is fenced, disinfection barriers are installed. To escape contamination of the farm territory with manure transported to the field, a separate gate for automobile transport is planned. The territory is divided into functional zones. The operating farm has the following sectors and zones: milk production and heifers growing sectors are divided into two zones: feeding zone and zone for keeping and preparation of manure for usage. The project also foresees complex development of the territory including its gardening and taking into account the object functional assignment and peculiarities. Installation of outdoor lamp posts is planned. Level of air pollution in the dwelling area does not exceed standard values, thus, negative effect on population is not forecasted. The project decisions have passed the state sanitary and epidemiological expertise.

Project documentation for Farm 2, including evaluation of environmental effect, is elaborated by Soyuzspetsbud Plius Ltd. Company, Dnipropetrovsk. Now the project is passing state expertise. The project implementation does not lead to worsening of environment in the area of the project allocation and in the attached territories.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

In accordance with the requirements of the task for the EIA materials elaboration as well as taking into account the analysis of the correspondent project materials, the following conclusion was drawn, that air will be the core component in environmental effect evaluation.

Such components as soil and water are viewed among other environmental components that can be affected by the envisaged activity in case of failure to perform the adopted project decisions as well as measures to ensure a normative state of environmental.

Air

Technological processes of livestock keeping and manure storing as well as cogeneration plant operating on biogas and the vehicles' engines will be the main sources of contaminants formation that will be emitted to air.

Land concentrations 32 were calculated within the EIA elaboration to evaluate air ecological state, taking into account the effect of the contaminants emissions sources.

The calculation was made by means of the PEC (personal electronic computer) on the basis of the "EOL" software, developed by the SRI research institute, approved and recommended by the Ministry of the Environmental Protection of Ukraine No. 11-5-15-11 of 16.04.97.

There was a conclusion drawn on the basis of the contaminants dispersion analysis results that after the envisaged reconstruction along with Farm 1 expansion as well as a biogas plant construction the maximum concentrations of the whole range of contaminants, contained in emissions, will meet the fixed regulations and will not exceed maximum permissible concentration (MPC). Calculation results of the concentrations got for checkpoints in a dwelling area confirm the aforesaid.

In the EIA materials it is stated that slight excess (1,06 MPC) of nitric dioxide in a checkpoint NO.5 in the sanitary and protective area not adjacent to the dwelling area, is viewed in the emergency situation only, the duration of which is 24 hours a year, when heat generator of the biogas plant operates on a diesel fuel along with the flare candle for biogas combustion. The value of nitric dioxide concentrations in the dwelling area (No. 1...No. 4) meets the normative demands.

Due to the fact, that after the envisaged reconstruction along with the Farm 1 expansion and the biogas plant construction, maximum contaminants land concentrations in the checkpoints in the dwelling area located on different distance from the farm territory, have the values of less than MPC , in the EIA it is stated, that the sanitary and protective area can remain within the fixed limits, in particular: 160 m from the North, 150 m from the North East, 260 m from the East, 250 m from the South East. In the North West, West, South West and South the sanitary and protective area remains within the normative limits.

Water

A number of engineering measures is envisaged by the project to prevent possible contamination of subsoil waters with the Farm 1 sewers.

After manure flush in parlors sewers are collected in reservoirs and pumped again to the cow's sumps for the manure flush. In case of overfilling tanks for sewers accumulation the latter are pumped into the manure ditches of the livestock sheds.

Industrial sewers from washing the equipment of the veterinary area get to the manure ditches of the livestock sheds as well.

Thus, all industrial sewers finally get to the manure storages. Total amount of sewers is 31,0 thousand t/year. Sewers from the service premises in the amount of 12,5 m^3/day are accumulated in a pumping station and are pumped out to purifying installations.

Confluent sewerage system envisages removal of "clean" and "dirty" sewers. Confluent sewerage sewers, contaminated with manure, are led by an open system of troughs to reservoirs for confluent sewers accumulation with the volume of 100 m^3 and are pumped out to manure storages. The amount of sewers is 11,8 thousand cubic meters a year, including 4,1 thousand m^3/year from the existing farm and 7,7 thousand m^3/year from the farm expansion. Sewers from the clean area are thrown off to the terrain.

Thus, sub soils are protected from contamination with the Farm 1 sewers.

Soils

[32] Reconstruction with the existing milk farm expansion in the village of Velykyi Krupil', Zgurivsk rayon, Kyiv oblast. Working design, Volume 1 EIA, «UKRNDIAGROPROEKT», Kyiv, 2008.

Soils will be protected from wind and water erosion by means of planting trees, bushes as well as sowing perennial grass on the part of the site free from buildings and correspondently designed. The total planting area is 139846 m^2.
Planting should be performed after laying all underground utilities and developing roads infrastructure.
In the dwelling area planting of two rows of trees is envisaged, in the area of the common-use land – planting of one row of trees is planned. The trees should be resistant to contaminants emissions effect.
Surface waters will be taken by roadway troughs to terrain. Confluent sewers dirtied with manure are taken to reservoirs for confluent sewers accumulation and then to the manure storage.
A separate exit for the vehicles, taking manure to the fields, is envisaged to prevent dirtying of the farm territory with manure. Making hard pavement of all internal roads on the site, areas or parking lots is envisaged to prevent mineral oils getting into soils. To gather garbage and everyday wastes the site will be covered with hard pavement and equipped with special containers.
Besides, the territory cleaning and watering as well as removal of industrial and everyday wastes is envisaged.
Design solutions, foreseen for subsoil waters protection from possible industrial and confluent sewers dirtied with manure are completely acceptable for the soils protection.
To ensure normative state of environment as well as ecological safety the project decisions include a number of environmental protection measures, among which are resource-saving and protective ones.

Resource-saving measures:

- expedient use of land resources due to location of the envisaged activity within the territory of the allocated land parcel not occupying additional area;
- expedient use of water withdrawal not causing production of the static reserves of water-bearing layers as the calculated decrease of water level in the designed well is less than acceptable;
- reduction of drinking water consumption due to the usage of milking parlors sewers for transporting manure;
- energy consumption within maximum capacity.

Planning and protective measures:

- general layout elaboration, taking into account the terrain;
- division of the planned object territory into functional zones, taking into account technological interconnection of buildings and constructions;
- planting of greenery in the area free from buildings to protect soils from wind and water erosion;
- two-row planting of trees, resistant to contaminants effect, in the dwelling area and one-row planting in the area of the common-use land;
- usage of ecologically safe and energy saving technologies due to the livestock cold keeping, making for contaminants formation processes delay;
- ecologically safe manure treatment due to quarantine and its full usage as organic fertilizer while growing fodder and grain crops;
- creation of correspondent conditions for environmental protection from bringing animals' contagions and population protection from diseases thanks to availability of vet institutions at the farm pursuant to the requirements VNTP-AIC-07.06 "Veterinary objects";
- creation of relevant conditions for corresponding to the norm contaminants due to the increase of the height of the emissions sources from the livestock sheds as well as installation of automatic scratching devices for the livestock in the sheds;
- usage of the sealed pipelines for transporting pure manure (manure without bedding) and equipping manure storages with waterproofing that impedes manure getting to soils and subsoil waters;
- covering manure storages with a special tape decreasing ammonia emissions during manure storing;

- using a biogas plant for manure processing after which fertilizers can be immediately used as they contain neither pathogenic microflora, nor weed seeds, nor nitrates, nor peculiar smell that essentially reduces chemical as well as bacterial contamination of soil, water and air;
- purification of residential sewers and their utilization on the absorption fields;
- using confluent sewers dirtied with manure as organic fertilizers;
- establishing I, II, III belts of the Sanitary protection zones (SPZ) for water wells;
- applying leak free cementation to prevent water seepage into water-bearing layer;
- using in the emergency state the biogas unit heat generator as an energy supply source reducing the need in additional energy supply source (diesel power station of the existing farm) and thus reducing negative environmental effect.

The adopted set of design solutions meets ecological and sanitary requirements as to the insurance of the planned object performance reliability. After-effect on the air will be made after the expansion completion, within the framework of the object operation, taking into account all project environment protection measures, aimed at ensuring environment normative state. Contaminants emissions into the air will be viewed as after-effects. Emissions total capacity will be 646,2 t/year.

In case of the envisaged farm expansion and the biogas plant construction due to the fact, that contaminants land concentrations in the checkpoints in the dwelling area located on different distance from the farm territory (from 150 to 260 m), have the values of less than MPC, in the EIA it is stated, that the sanitary and protective area can remain within the fixed limits, in particular: 160 m from the North, 150 m from the North East, 260 m from the East, 250 m from the South East. In the North West, West, South West and South the sanitary and protective area remains within the normative limits.

Thus, the Farm 1 expansion from 2000 cows to 4000 cows along with the construction of the biogas plant and generation of heat and electric energy by the co generator in the village of Velykyi Krupil', Zgurivsk rayon, Kyiv oblast is substantiated and feasible.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

Velykokrupilska village council that presents general public does not object to the planned Ukrainian Dairy Company Ltd. activity and agrees with the location of land site for construction of Ukrainian Dairy Company Ltd. Expanded Dairy farm object on the Velykokrupilska village council, Zgurivsky region, Kyiv oblast reserve lands. This is certified by the examination act of the land site for construction.

Reconstruction with the operating dairy farm extension is foreseen on the common-use lands that boarder with the operating dairy farm.

Complex measures as to ensuring normative environmental state, including change of manure management system (biogas plant), and the results of contaminants spreading calculations allow to expand the operating dairy farm from 2000 cows to 4000 cows taking into account the corresponding sanitary and protection zone for the operating dairy farm agreed with the Ministry of Health Care of Ukraine.

The planned object will be equipped with the necessary engineering complex, water supply system and sewerage system, electricity supply, ventilation, system of pure manure transportation to manure storage.

Taking into account that soil concentrations of contaminants, which are the part of the planned object emissions, in the dwelling area do not exceed fixed standards[33] and taking into consideration complex of measures as to ensuring normative state of environment it's possible to assert that the project activity will not have any negative effect on social environment.

The list of previous approvals and expertise contains the following documents:

[33] Reconstruction with the existing milk farm expansion in the village of Velykyi Krupil', Zgurivsk rayon, Kyiv oblast. Working design, Volume 1 EIA, «UKRNDIAGROPROEKT», Kyiv, 2008.

- Resolution of the Velykokrupilska village council on giving allowance for preparing materials on approval of the object location of 29.08.07, #6-15-975/978;
- Examination act of the land site for the object construction issued by Zgurivska regional state administration commission;
- Resolution #70 of the Velykokrupilska village council on giving allowance for carrying out design and research activities in the framework of the Operating Dairy Farm Reconstruction object of 19.08.07.

All above mentioned documents have positive conclusions as to the previous approval of the land site location within the Velykokrupilska village council territory for the operating dairy farm extension with biogas plant construction for manure fermentation and heat and electrical energy generation in Velyky Krupil village.
Komarivska village council that presents general public of Komarivka village, Borzniansky region, Chernigiv oblast, does not object to the planned activity of the Ukrainian Dairy Company Ltd. on construction of a dairy farm and biogas plant for livestock manure fermentation and heat and electrical energy generation.
Project documentation for Farm 2, including evaluation of environmental effect, is elaborated by Soyuzspetsbud Plius Ltd. Company, Dnipropetrovsk. Now the project is passing state expertise.

All comments and remarks received in the process of discussing and considering the project at the meetings in Rural Councils as well as in the State Department of Environmental Protection in Kyiv oblast, were mostly associated with the explanation of some aspects of the project, calculations as to environmental effect, rather than with the objections to the project implementation. Core requirement of the interested parties was project environmental effects calculation and evaluation to be made in accordance with the standard of Ukraine, Order of the State Construction Committee A.2.2-1-2003 «Composition and content of the materials on the evaluation of the environmental effects while designing and constructing plants, houses and buildings. Main provisions of Design» (EIA), approved by the Order of the State Construction Committee of Ukraine of 15.12.2003 No. 214 valid since 01.04.2004.

All questions and remarks, received from the interested parties, were taken into account and explained on the basis of calculations presented in the Part “Environmental Effects Evaluation”, included into the draft project documentation, approved by the state expert review.

Annex 1

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Annex 2

BASELINE INFORMATION

Table A2.1. – Average annual temperatures in Kyiv and Chernigiv oblasts for the period of 1990-2006, °C.

Year	**Kyiv oblast**	**Chernigiv oblast**
1990	9,2	8,3
1991	8,1	7,3
1992	8,4	7,7
1993	7,3	6,4
1994	8,3	7,3
1995	8,5	7,8
1996	7,3	6,3
1997	7,6	6,7
1998	8,1	7,1
1999	9,4	8,4
2000	9,2	8,4
2001	8,8	7,8
2002	9,6	8,5
2003	8,2	7,4
2004	8,7	7,8
2005	8,7	7,8
2006	8,4	7,4
Arithmetic average value for the period of 1990-2006	*8,5*	*7,6*

Quality control procedures for data used in calculations of baseline emissions.

Within the framework of quality control procedures, the calculated values of the dry matter amount in cows' manure (5,9 kg/head/day) and ash fraction in a dry matter (0,1485) were compared with similar regulatory data for cattle (DM - 6,3 kg/day and ASH - 0,16)[34]. Results of the comparison indicate conformity of the aforesaid data. Both sources of data (manure analysis and regulations) provide reliable and accurate information. That is why the data, received from manure physical-chemical analysis at the project objects from conservative standpoint were used in the baseline calculations.

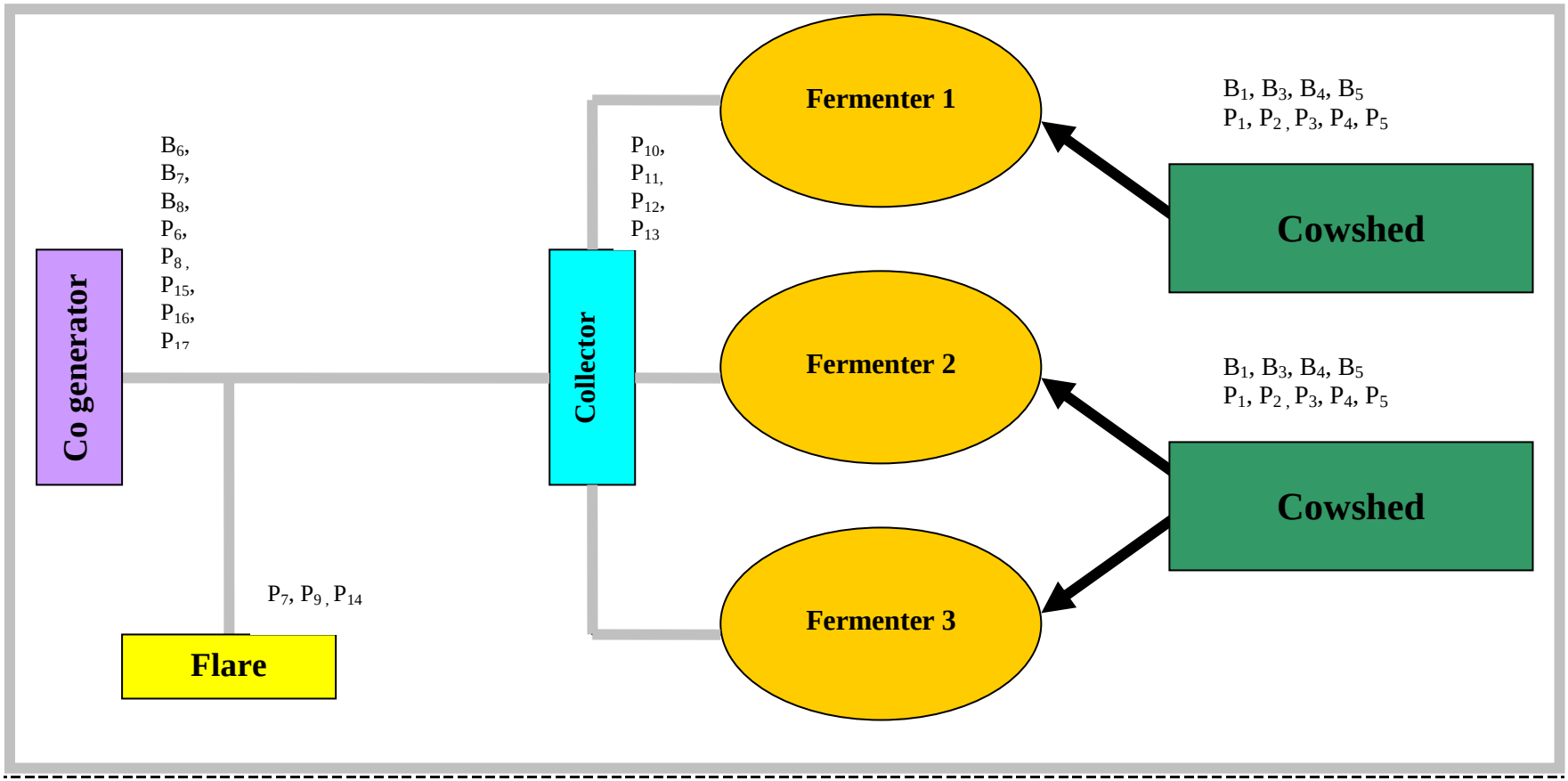
Besides, pursuant to the requirements set in AMS-III.D methodology, value VS , calculated on the basis of formula 10 (5,0 kg/head/day), was compared with the correspondent default value set in the 2006 IPCC Guidelines (4,5 kg/head/day[35]). 10% discrepancy between the aforesaid values can be explained by the fact that the default value of amount of volatile solids excreted has been elaborated by the IPCC primarily for the countries of Eastern Europe, but the national data indicate the specificity of fodder rations for milk herd cows that are owned by the Ukrainian Dairy Company Ltd.

[34] Technological designing departmental regulations of Agro-Industrial Complex. 1.05. Cattle-breeding.

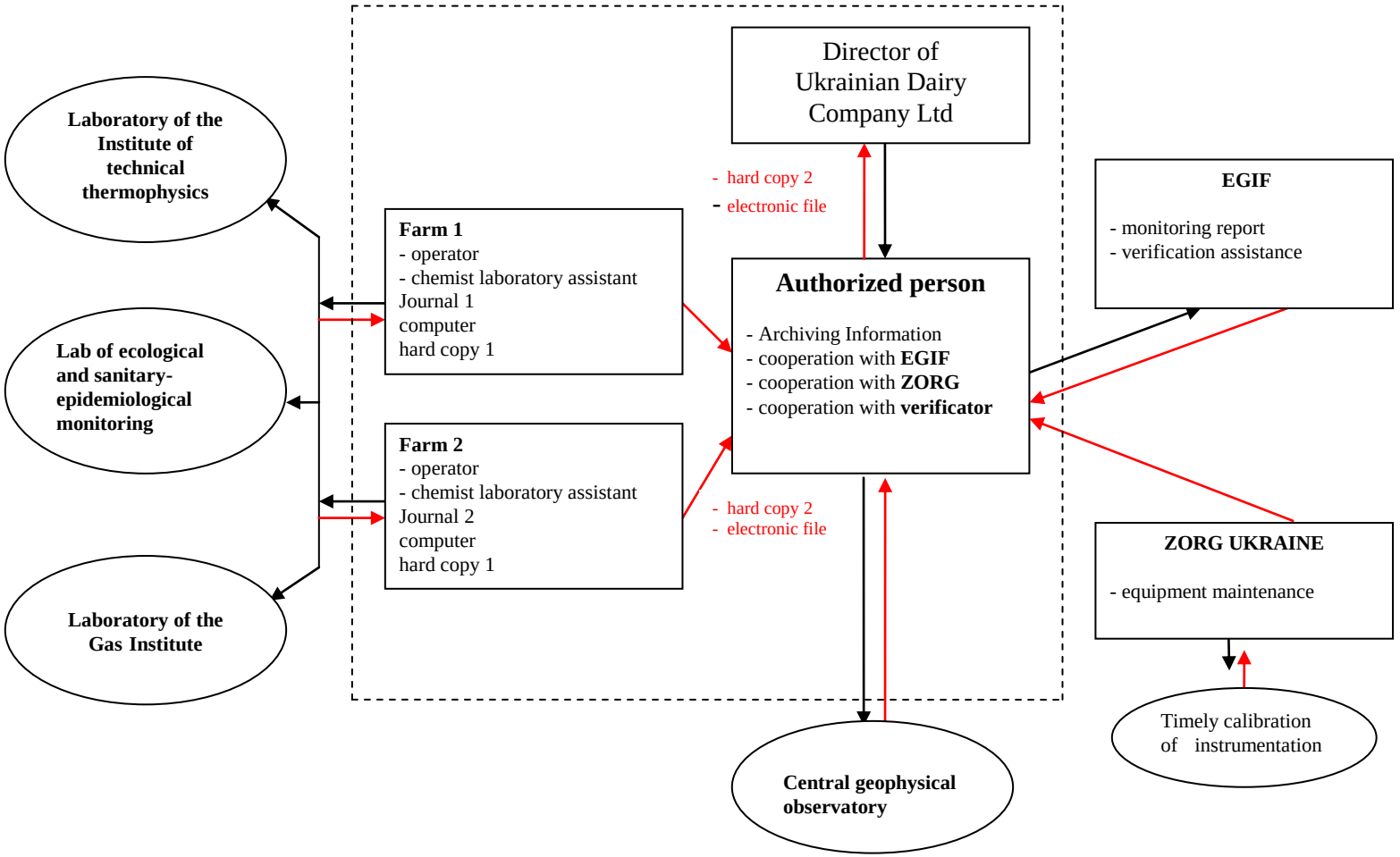
[35] Guidelines for National GHG Inventories IPCC 2006, volume 4, chapter 10, table 10 A-4.

Annex 3

MONITORING PLAN



Picture A 3.1- Monitoring scheme for GHG emission reductions project for farm



Picture A 3.2- Information flows scheme for monitoring implementation.

Annex 4

ESTIMATION OF GREENHOUSE GAS EMISSION REDUCTIONS FOR THE PERIOD 2013-2023

According to expert estimates, based on the study of the technical characteristics of biogas equipment and German technology used a corrective factor of 0,8 was defined to determine emissions reductions for the project during the 2013-2023. This factor takes into account wear of the main equipment as well as possible changes of the baseline scenario. The values of the calculated emissions are given in Table A4.1. Actual values of reductions for the period of 2013-2023 will be determined on the basis of the monitoring results.

Table A4.1- Scope of the corrected GHG emissions reductions for the period of 2013-2023.

Year	**Calculated scope of the emissions reductions, t CO_2-eq.**	**Corrected scope of the emissions reductions, t CO_2-eq.**
2013	69 386	55 509
2014	69 386	55 509
2015	69 386	55 509
2016	69 386	55 509
2017	69 386	55 509
2018	69 386	55 509
2019	69 386	55 509
2020	69 386	55 509
2021	69 386	55 509
2022	69 386	55 509
2023	69 386	55 509
Total 2013-2023	***763 246***	***610 599***

Annex 5

PROJECT FINANCING

A5.1 Estimate of project implementation (EUR)

Project capital costs and brief description of their assignment is given in Table A5.1.

Table A5.1- Project value and capital costs generalized structure (EUR).

Index	**Farm 1**	**Farm 2**
Designing	59 250	100 000
Construction and assembly works	1 125 750	3 000 000
Equipment	1 015 000	1 900 000
Contingent expenses	110 000	250 000
Total	2 310 000	5 250 000
General project value		**7 560 000**

A5.2 Calculated annual operational expenses (EUR)

Annual operational expenses and brief description of their assignment is given in Table A5.2.

Table A5.2- Calculated annual operational expenses (EUR).

Index	**Farm 1**	**Farm 2**
Fermenters maintenance	15 000	22 500
Cogenerators maintenance	15 000	22 500
Staff Salary	12,000	12,000
Other	3 000	3 000
Total	45 000	60 000
General project operational expenses		**105 000**

A5.3 Financing sources

As the Ukrainian Dairy Company Ltd. does not have enough own financial resources to implement the project, the only way to finance the project is through the commercial bank credit. While determining the financial structure of the project returns from the ERUs sales to the foreign buyer are to be taken into account assuming that these funds can ensure timely payment of the credit during the active phase of the project.

Preliminary project financing structure is given in Table A5.3.

Table A5.3 - Financing source, %.

Index	**Farm 1**	**Farm 2**
Own resources	0	0
Bank credit	100	100

Selling of ERUs is estimated to cover 38% of the credit. Besides returns from ERUs selling will give an opportunity to ensure cash flow that will be enough for payment of percents by credit.